ONTARIO ATTORNEY GENERAL LAW LIBRARY
HV 8073 O57 1997 STK
Laboratory guide for the investigator
00007110

VT INCEPIT FIDELIS SIC PERMANET
Ontario

LABORATORY GUIDE
FOR THE
INVESTIGATOR

HV
8073
O57
1997

HV 8073 057 1997
Ontario.
Laboratory guide for the
investigator 53483791

HV 8073 057 1997
Ontario.
Laboratory guide for the
investigator 53483791

MINISTRY OF THE
ATTORNEY GENERAL
LAW LIBRARY

ONTARIO
MINISTRY OF THE
ATTORNEY GENERAL
LAW LIBRARY

MAY 25 1998

Ontario

LABORATORY GUIDE

FOR THE

INVESTIGATOR

**THE CENTRE OF FORENSIC SCIENCES
PUBLIC SAFETY DIVISION
MINISTRY OF THE SOLICITOR GENERAL
AND CORRECTIONAL SERVICES**

CENTRE OF FORENSIC SCIENCES

R.J. Prime
Director (Acting)

R. Higaki
Manager (Acting)
Northern Regional Forensic Laboratory

34 83791

LABORATORY GUIDE FOR THE INVESTIGATOR

First edition 1962

Second edition 1971

Third edition 1978

Fourth edition 1984

Fifth edition 1997

ALL COMMUNICATIONS SHOULD BE
DIRECTED TO

THE DIRECTOR
CENTRE OF FORENSIC SCIENCES
25 GROSVENOR STREET
TORONTO, ONTARIO
M7A 2G8

TEL (416) 314-3200
FAX (416) 314-3225

OR

THE MANAGER
NORTHERN REGIONAL
FORENSIC LABORATORY
70 FOSTER DRIVE, SUITE 500
SAULT STE. MARIE, ONTARIO
P6A 6V3

TEL (705) 945-6551
FAX (705) 945-6569

AFTER HOURS:

CENTRE OF FORENSIC SCIENCES

Telephone (416) 314-3200

OR

NORTHERN REGIONAL
FORENSIC LABORATORY
Telephone (705) 945-6550

Digitized by the Internet Archive
in 2017 with funding from
Ontario Council of University Libraries

https://archive.org/details/mag_00007110

TABLE OF CONTENTS

		PAGE
PREFACE		7
PART I	GENERAL INFORMATION	9
PART II	FORENSIC SERVICES:	21
	BIOLOGY (INCLUDING DNA)	23
	CHEMISTRY	61
	DOCUMENTS EXAMINATION	93
	FIREARMS AND TOOLMARKS EXAMINATION	105
	PHOTOANALYSIS	115
	TOXICOLOGY	123
	PATHOLOGY	133
PART III	MORE COMMON INVESTIGATIONS:	137
	BREAK, ENTER AND THEFT	138
	FATAL MOTOR VEHICLE COLLISIONS	139
	FIRES AND EXPLOSIONS	139
	FIRE DEATHS	140
	HIT AND RUN	141
	HOMICIDE AND OBSCURE DEATHS	142
	IMPAIRED DRIVING	143
	SEXUAL ASSAULTS	144
FIGURES	1a. Packaging dry material in paper	14
	1b. Placing packaged sample in envelope	15
	2. Taping a surface for foreign hairs and fibres	34
	3. Combing hairs for fibres	42
	4. Overall photograph of a bloodstain pattern	37
	5. Closeup photograph of a bloodstained area	38
	6. A pulled hair with attached root sheath	43
	7. Collecting paint and other dry material from a vertical surface	63
	8. Properly packaged sample suspected of containing a volatile liquid	67
	9. Excised tissue with bullet hole	110

PAGE

10. Tissue with bullet hole immersed in 10% formalin 110
11. Physical comparison. The numbered areas indicate where a physical match or comparison may occur 117
12. Properly packaged specimens for toxicological analysis 127

APPENDICES A. Case Submission Form (CFS 069) 147

B. Instructions for removal of gunshot residue from hands 149

C. Regions of Ontario served by the Northern Regional Forensic Laboratory 151

D. Services not provided by the Forensic Laboratory 153

INDEX 158

PREFACE TO FIFTH EDITION

The Fifth Edition of Laboratory Guide for the Investigator incorporates changes in the service capabilities which have taken place since the publication of the Fourth Edition in 1984.

Perhaps more than at any other time, the intervening years have seen some significant changes in the forensic science services that the Centre of Forensic Sciences provides. Service to Northern Ontario has been enhanced by the opening of our regional facility in Sault Ste. Marie. The Toronto Laboratory is now an accredited laboratory and the Northern Regional Forensic Laboratory will be seeking accreditation in the near future. DNA technology has had a revolutionary impact on those investigations which involve the examination of body fluids and changes in technology, while most apparent in the forensic biology field, have led to ever increasing capabilities in the other branches of forensic science. It is expected that changes will continue which will lead to constant improvement in the way in which the Laboratory can assist the investigator.

This Edition continues to be primarily a guide to the investigator and is not intended as a manual of laboratory procedures. Part I deals with the structure, purpose and general functions of the Centre of Forensic Sciences (CFS) and the Northern Regional Forensic Laboratory (NRFL). It also outlines general procedures and instructions common to all requests for service. Part II is divided into divisions dealing with the various services available. Each of these divisions is sub-divided by type of physical evidence material and contains information on:

1. Collection, preservation, packaging and special precautions.
2. Comparison samples - types, amounts and methods of collection.
3. Significance of possible findings.

PART III is intended as a ready reference to the usual types of physical evidence that may be found in the more common investigations such as homicide, sexual assault, hit and run, etc. It must be stressed that this is only a brief summary of what evidence may be present and should be sought. It should not be used as a comprehensive check list and does not replace the normal observation, curiosity and ingenuity of the experienced investigator.

This book is not exhaustive. New problems continually confront the investigator. Some of the information contained herein will become outdated, some perhaps by the time it reaches the reader. The staff of the two forensic laboratories will be pleased to discuss your requirements whenever the need arises.

Preparation of this edition has been under the direction of the retired Director of the Centre, G. Cimbura. Significant contributions were made by G. Dawson, B.M. Dixon, R. Higaki, J. Mayer, L. McAuley, P. Newall, L. Newbury, F.I. Nielsen, and other members of our staff. I would like to thank all of the staff involved for their contributions to this edition.

R.J. Prime
(ACTING) DIRECTOR

PART I

GENERAL INFORMATION

Introduction

The Centre of Forensic Sciences (CFS) came into being in 1966 with the passing of an Order-in-Council changing the name of the Attorney General's Laboratory and broadening the terms of reference. The Attorney General's Laboratory had been organized in 1951. The Centre is a Branch of the Public Safety Division of the Ministry of the Solicitor General and Correctional Services of the Province of Ontario. In 1986, as part of the Northern Initiative Program, the Ontario Government approved the establishment of the first regional forensic science laboratory. The new laboratory, the Northern Regional Forensic Laboratory (NRFL), located in Sault Ste. Marie, became operational in July 1992.

The objectives of the two forensic laboratories are:

To assist in the just and effective enforcement of the law through:

1. The production of evidence in a legally admissible form for law enforcement officers, crown attorneys, lawyers, coroners, pathologists and official investigative agencies by means of the scientific examination, analysis, evaluation and interpretation of physical objects and materials.

2. The provision of educational programmes and materials for persons and agencies using forensic science services.

3. The conduct and encouragement of research to expand forensic science services.

The Northern Regional Forensic Laboratory provides services to regions of Northern Ontario (see Appendix C) and the Centre of Forensic Sciences provides services to the remainder of the Province. These services include biological, chemical, photographic, toxicological, firearms/toolmarks and document examination. All are provided at no cost to all official investigative agencies and to defence counsel in criminal cases. In addition, some of the services are available to counsel in civil cases in those aspects of forensic science where such services are not available elsewhere in the Province. Fees are charged for services in civil cases and are paid to the Treasurer of Ontario.

In all cases, qualified forensic scientists are available to provide testimony as to the findings and the interpretation of the findings. No charge is made for court appearances except in civil cases.

Staff of the two forensic laboratories are also available for "on-the-scene" examinations upon request. Such requests should be made by telephone to the Director's Office in Toronto or the Manager in Sault Ste. Marie where the decision will be made as to the necessity for such examinations. After normal working hours, senior members of the staff are on call and available in Toronto through telephone No. (416) 314-3200 and in Sault Ste. Marie by telephoning (705) 945-6550.

Laboratory reports in criminal investigations are normally addressed to the crown attorney responsible with a copy to the investigating officer. Where a death is involved a copy is also sent to the Chief Coroner's Office. In coroner's cases, reports are sent to the coroner with copies to the pathologist, the investigating officer and the Chief Coroner's Office.

Items are received from defence counsel in criminal cases on the written understanding that counsel will provide a copy of the report to the crown attorney. Civil cases are received only from lawyers on their acceptance of the Centre's schedule of fees, and are reported only to the submitting lawyer.

Role of Forensic Science

The importance of forensic science in criminal and other investigations is almost impossible to assess with any accuracy. In some investigations and trials, its role is relatively minor and often the outcome would be the same without any scientific evidence. There are, however, an increasing number of cases where forensic science can and does make a vital contribution. As the body of knowledge and techniques increases, scientific evidence becomes even more important in a greater proportion of cases.

For forensic science to make its proper contribution to the administration of justice, it is essential that investigators have an understanding of what the forensic laboratory can and cannot do. Investigators must also have an appreciation of what they must do to make the best use of the laboratory services available.

The examination of a case in a forensic laboratory is usually for the purpose of fulfilling one or more of the following functions:

1. Identifying objects and materials.

   If provided with sufficient sample reasonably free from contamination, the laboratory should be able to identify almost any object or material.

2. Revealing additional information.

   Often, information can be developed in the laboratory about an object or material that is invisible, obscured or not otherwise apparent to the investigator.

3. Detecting and quantitating drugs or poisons in body specimens.

4. Comparing objects and materials

   The purpose of these examinations is to determine if a known and questioned sample have a common origin. Such comparisons may result in one of three conclusions:

   (a) The samples had (or did not have) a common origin i.e. certainty.

   (b) The samples probably came (or did not come) from the same source i.e. probability.

   (c) The samples could have come from the same source i.e. possibility.

These latter two conclusions can at times be frustrating to the investigator particularly when, from all of the circumstances of the case, it is reasonable to believe that the samples did have a common origin. It must, however, be appreciated that the conclusion of the laboratory examiner must be based upon the demonstrable scientific evidence available and cannot be influenced by the other circumstances of the case. These other circumstances may allow the court to reach a more positive conclusion, but not the laboratory.

Although the value of the "could have come" type of conclusion is obviously limited, it should not be dismissed summarily. It can combine with other circumstances to provide the foundation for an effective summation by counsel or to assess the credibility of an alibi. For example, although the laboratory may only be able to say that some soil on a suspect's shoes could have come from a specific location, it may well be able to say with certainty that it did not come from the place where the suspect claims it did.

Since a laboratory cannot afford or justify the time required to make an exhaustive examination of every item submitted, it is essential that requests for examination be confined to those examinations which might produce relevant information. Therefore, to make the most effective use of the forensic laboratory, investigators must form a clear concept in their own mind of what questions they wish the laboratory to attempt to answer. A few minutes spent before the items are submitted considering the questions requiring answers will usually result in fewer but more useful items being submitted and thereby more efficient use of the laboratory's service.

In addition to the proper selection of items to be examined, the investigator must take particular care to see that they are properly identified, preserved and packaged for transport and that proper comparison samples are collected. Failure to do so may result in a loss or deterioration of the sample so that no examination can be made or, even if an examination can be made, the inability to identify the sample may result in its inadmissibility as evidence in court.

Basic Procedures

Although specific instructions for different categories of evidence are given in Part II, the following general instructions apply in all cases.

Marking Items for Identification

Some identifying mark (usually the investigator's initials) should be placed on the object provided that:

1. The object is large enough and can be marked.
2. The marking will not interfere with or destroy evidence to be examined.

Where this is not possible, the item should be placed in an appropriate container and the container marked for identification. Numbered seals are available from the Centre to identify containers of items that cannot or should not be marked.

Packaging and Labelling

Every effort must be made to preserve the material in the condition in which it was found. Exceptions to this general rule are items stained with blood or other body fluids which must be air-dried prior to packaging to prevent decomposition. Blood samples and body organs should be refrigerated, volatile samples such as gasoline should be placed in airtight containers, and objects for toolmark examination should be protected from scratches or abrasions.

Great care must be taken to ensure that comparison samples are kept completely separate from questioned samples. A tool should never be fitted into a toolmark, an item of clothing should never be tried on a suspect, a knife should never be fitted into a wound, questioned writing should never be highlited or circled. Liquid comparison samples or other comparison samples in glass containers should never be placed in the same package as the questioned samples because of the risk of breakage and resultant contamination of the samples.

Small items such as paint and glass chips, bullet and paper fragments, hairs, etc., should be carefully wrapped in a standard 8 1/2" x 11" paper sheet as shown in Fig. 1a, before placing in a container (Fig. 1b). Items of clothing should always be packaged individually in plastic or paper containers. Each item or container should be labelled with the following information:

a) What the item is,
b) Where it was found,
c) When it was found,
d) Who found it.

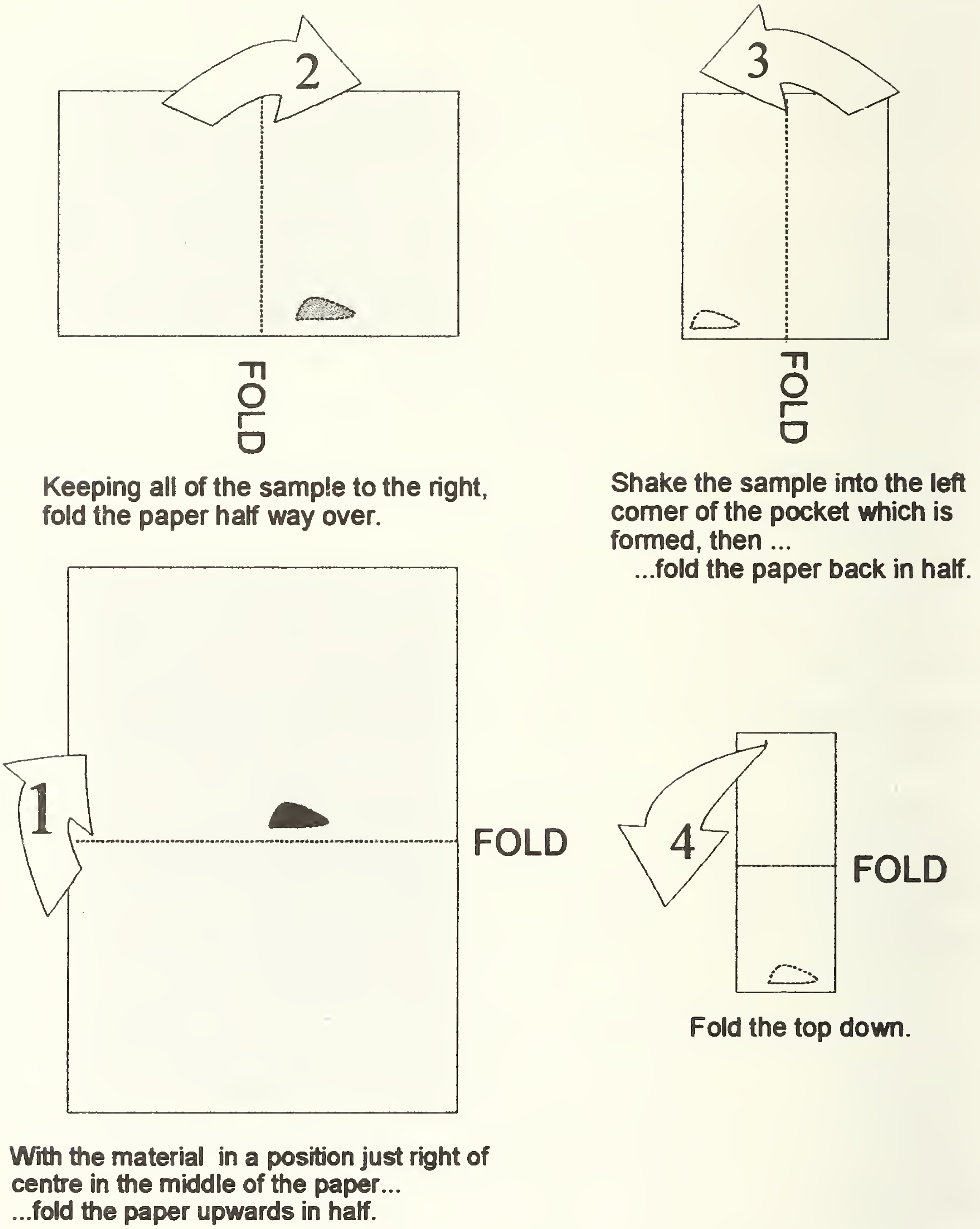
The initials or signature of all persons who have had custody of the item should be added. Labels should be as concise as possible and words that imply a conclusion such as "victim", "bullet hole", "murder weapon", must be avoided. The tag or label must be firmly affixed.

Containers used to package evidence must be properly closed. Glass jars such as mason jars must be properly insulated with packing material to prevent breakage during transit. Cartons should be taped shut; plastic and paper bags should be folded at the top and stapled shut; plastic boxes with loose fitting lids should be secured with tape.

It is not necessary to seal every container (other than those mentioned above) with a numbered seal; one seal on the outer container is sufficient. If the items are delivered personally by the investigator even this is unnecessary as a seal will be affixed by the investigator at the Laboratory Receiving Office.

Documentation

All cases submitted to the forensic laboratories must be accompanied by a Case Submission Form CFS-69 (Appendix A.) All applicable parts of this form must be completed in type or clear handprinting giving full mailing addresses of those persons to receive copies of the reports. The following information may assist in the proper completion of the form.



Keeping all of the sample to the right, fold the paper half way over.

Shake the sample into the left corner of the pocket which is formed, then ...
...fold the paper back in half.

With the material in a position just right of centre in the middle of the paper...
...fold the paper upwards in half.

Fold the top down.

The Druggist's fold for collecting trace samples.

Fig. 1a Packaging dry material in paper

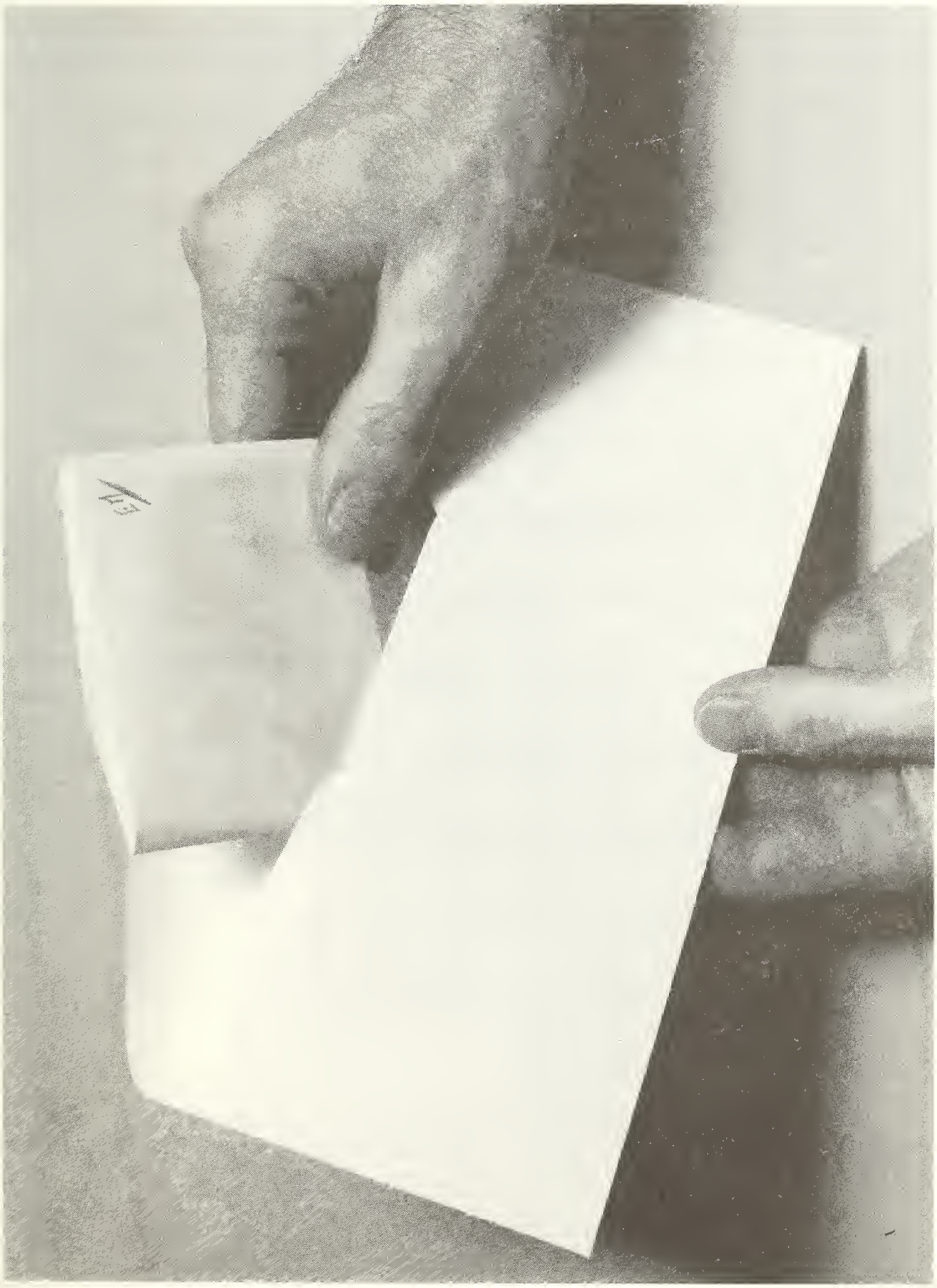


Fig. 1b Placing packaged sample in envelope

Accused/Suspect	Names of persons charged or suspected. Underline last names. Strike out the word that does not apply.
Complainant/Deceased	Names of the deceased or of the persons against whom the offence is alleged to have been committed. Underline last names. Strike out the word that does not apply.
Occurrence Location	City or Town of the police force or OPP Detachment with jurisdiction.
Submitted By	Name, mailing address and phone number of the person requesting the examination. This may be the investigator, identification officer or, in coroners' toxicology cases, the pathologist.
Chief Investigator	Name, mailing address and phone number of the person in charge of the investigation. If the submitter and chief investigator are the same, leave this area blank.
Case History	A concise description of the relevant events or circumstances leading up to, during and subsequent to the occurrence. A brief outline of any reconstruction of the occurrence. History of any infectious disease in cases where body specimens or stains are to be examined. Court or Inquest dates. See specific types of investigations for further information required.
List Items Submitted	All items being submitted, including those from Sexual Assault Kits (use format from "Forensic Evidence" form which accompanies the kit), should be listed, numbered and described individually.
Examination Requested	Description of the examination or type of information required.

If the space provided on the Case Submission Form is inadequate, continue on a second form or a plain sheet of paper.

The green copy should be retained by the submitter and the remainder (with carbons attached) forwarded with the items. The pink copy will be returned to the submitter as a receipt. When the examinations are completed, the white copy will be returned with the items.

Accommodation will be made for computer-generated forms.

Continuity of Items

Delivery

Although personal delivery of materials is desirable for adequate consultation, distance and time limitations often preclude this. Registered mail, express or courier service are acceptable alternatives. All parcels and all correspondence should be addressed to:

The Director,
Centre of Forensic Sciences,
25 Grosvenor Street,
Toronto, Ontario. M7A 2G8.

or

The Manager
Northern Regional Forensic Laboratory
70 Foster Drive, Suite 500,
Sault Ste. Marie, Ontario. P6A 6V3

Parcels delivered personally to the laboratories after normal working hours must be placed in the lockers or refrigerators provided for that purpose. Instructions for the proper use of the lockers are prominently displayed in the locker area which is accessible through the security office.

Major or unusual cases should be delivered by someone completely familiar with the case. This allows for a full discussion of all pertinent matters. Should an immediate examination be required to assist an investigation, a telephone call in advance to the Centre Receiving Office (CRO) in Toronto (416-314-3216) or the Regional Lab in Sault Ste. Marie (705-945-6552) will assist in ensuring that an examiner is available.

Vehicles and other bulky items should be delivered to the automobile examination areas at the CFS or the NRFL. Advance notice to the Centre's CRO or the Regional Lab will facilitate delivery. These areas are accessible after hours through the respective security offices:

Toronto: (416) 314-3486
Sault Ste. Marie: (705) 945-6550

Receiving Items

All items submitted to the Laboratory for examination are received in the Centre Receiving Office in Toronto or by an examiner in the Regional Forensic Lab in Sault Ste. Marie. The types of examination likely required are determined and only items relevant to the investigation and suitable for forensic examination are accepted. If additional information or samples are required they will be requested at this time, although after the examination has commenced it sometimes becomes evident that other samples are needed. The screening and assessment discussions are done in conjunction with the forensic specialists involved whenever necessary.

Services not provided by the CFS or the NRFL are described in Appendix D. In addition, the following specialized services provided by the CFS are not presently available from the NRFL. These are soil comparisons, engineering and electronic examinations, breath-testing equipment repairs, document examination and DNA Profiling. The plans are to develop the latter two services in that facility in the near future. In the meantime, Northern Ontario cases requiring only the above specialized examinations should be submitted to CFS, however, cases requiring other examinations in addition to the specialized tests, should be submitted to the NRFL who will arrange with CFS for the necessary special tests to be carried out and reported.

Due to budgetary constraints, it has also been necessary to restrict the acceptance of certain types of cases and to reduce the types of examinations in others. These restrictions are detailed in Part II under the appropriate type of service.

The pink copy of the Case Submission Form is issued as a receipt for the items. On this receipt is noted the Laboratory file number, delivery mode, date and time as well as any seal number applied at time of delivery. The forensic area to which the items are assigned are indicated by their initial letters (B-biology, C-chemistry, D-documents, F-firearms, P-photography, T-toxicology). All subsequent requests for information as well as additional submissions in connection with the case should refer to the Laboratory file number.

Returning Items

The items, accompanied by the white copy of the Case Submission Form, are shipped to the submitter upon completion of the final report of the examinations unless other written instructions are received. Due to the perishable nature of toxicological samples they are not normally returned and are destroyed six months from the date reported unless other instructions are received. Items in some cases for document examination are returned with the report, while others are temporarily retained for the preparation of charts for court.

Materials Supplied by CFS

Blood Alcohol Kits

Breath Test Supplies: Some instrument replacement parts - contact Toxicology staff of CFS

N.B. Supplies for roadside screening devices are not provided by CFS.

Case Submission Forms - Form CFS 069*

DNA Warrant Sample Collection Kits

Gasoline “marker” and field test kits**
Gunshot Residue Kits*
“Laboratory Guide for the Investigator” books
Nitroglycerine neutralizer**
Numbered Seals*
Nylon bags (for fire debris)
Serial number restoration kits**
Sexual Assault Evidence Kits
Tubes containing preservative/anti-coagulant powder for blood and urine (for alcohol and drug analysis)*.

* Also available from NRFL
**Consult with Chemistry staff of CFS prior to requesting these materials.

Requests for the above materials should be addressed to the CRO. Telephone prior to pick-up to ensure prompt service.

PART II

FORENSIC SERVICES

This part of the guide deals in more detail with the various forensic science services available. It is intended to provide information about the collection, preservation and packaging of physical evidence materials, the required comparison samples as well as the forensic significance of possible laboratory findings.

The forensic specialties described in this part are Biology, Chemistry, Documents examination, Firearms and Toolmarks examination, Pathology, Photoanalysis and Toxicology. Should additional assistance be required, contact appropriate staff at:

Centre of Forensic Sciences	**Telephone**	**Fax**
Centre Receiving Office	(416) 314-3216	
Biology Section	(416) 314-3276	
Chemistry Section	(416) 314-3131	(416) 314-3225
Documents/Photoanalysis Section	(416) 314-3240	(all sections)
Firearms and Toolmarks Section	(416) 314-3231	
Toxicology Section	(416) 314-3143	

Northern Regional Forensic Laboratory

Telephone	(705) 945-6551
Fax	(705) 945-6569

Forensic Pathology Unit

Telephone	(416) 314-4040
Fax	(416) 314-4060

BIOLOGY

CFS - PHONE: (416) 314-3276
FAX: (416) 314-3225

NRFL - PHONE: (705) 945-6550
FAX: (705) 945-6569

The services provided by the Biology staff include:

1. Identification of body fluids such as blood, semen and saliva.

2. Examination of trace evidence, such as hairs and fibres.

3. Individualization of body fluids and hairs using DNA analysis.

4. Bloodstain pattern analysis.

5. Identification and comparison of botanical materials such as wood, plants and plant products.

SUMMARY OF SERVICES

Blood And Other Body Fluids

1. Stain Identification:

   Blood, semen, saliva can be identified. Tests for urine, faeces and vomitus are also available.

2. Species Determination:

   Analysis of blood and semen can be done to determine if a stain is of human origin. Non-human stains can be tested to establish the animal source to the level of family.

3. DNA Analysis and Comparison:

   Blood, semen, vaginal secretions and saliva, as well as bone, teeth and tissue, are routinely profiled by DNA analysis and compared to known samples from relevant individuals in the case. The results can either eliminate specific individuals or include them as a source of the questioned material.

   A variety of other bodily substances such as vomitus, urine, faeces and nasal secretions have been successfully profiled.

Bloodstain Pattern Interpretation

Analysis of bloodstain patterns at a scene, on weapons and on clothing can often provide information about the possible actions causing the patterns.

Hair Analysis

1. Source:
   Scalp hair can be distinguished from other body hair (such as beard, pubic and limb) and it may be possible to provide an opinion as to racial origin. It can often be determined if a hair has been forcibly removed.

2. Species Determination:
   Hair can be identified as being of human or animal origin. Animal hairs can be identified as to family.

3. DNA Analysis and Comparison:
   Hairs with some attached root sheath can be profiled by DNA analysis and compared to known samples from relevant individuals in the case. The results can either exclude specific individuals or include them as the possible source of the hair.

4. Physical Characteristics and Comparisons:
   In cases where there is little or no root sheath on hairs, comparisons can be made between hairs based on morphological and chemical characteristics to determine the possible origin of a particular hair.

Fibre Analysis

In some cases where there are no body fluid stains and no hairs, fibre analysis can be crucial in establishing a relationship between two objects or individuals. This type of evidence should not be overlooked and care must be taken not to contaminate a scene or item where fibre analysis may become relevant.

Fibre analysis also includes the examination of fabric impressions, ropes, cordage, buttons and fasteners.

Botanical Materials

1. Wood:
   Fragments of wood, slivers and sawdust may provide useful information in establishing a relationship between objects, individuals and locations.

2. Plant Material:
   Plant fragments, seeds, burrs and leaves may be useful in establishing contact with vegetation in a particular area. Unusual plant materials are often the most informative. Blades of grass and common plants and leaves are not usually examined.

COLLECTION AND PACKAGING

General Considerations

General Safety

1. LATEX GLOVES MUST BE WORN when handling and packaging any evidential samples. This will minimize your exposure to possible infectious agents and reduce the transfer of your DNA to items.

   Excessive talking, coughing or sneezing in the vicinity of the item may cause detectable amounts of your DNA to be inadvertently transferred to the item. Masks may be worn to minimize this risk.

2. GLOVES MUST BE CHANGED WHEN CONTAMINATED AND/OR WHEN HANDLING ITEMS FROM DIFFERENT SOURCES.

3. Disposable utensils (eg. razorblades, toothpicks) should be used whenever possible, using a new utensil for each sample collected. Scissors and forceps must be wiped with water or alcohol before being used to collect the next sample to prevent contamination between specimens.

Preserving Trace Evidence

1. All items must be handled and packaged with care to protect against loss or contamination of trace evidence such as hairs, loose fibres, paint chips, soil, gunshot residues, etc.
   For cases where fibre examinations will be done, package items in paper only; DO NOT USE PLASTIC BAGS.

2. For safety reasons, package items such as open-bladed knives in small cardboard boxes or other rigid containers. Package the item in a manner that limits its movement within the box in order to minimize loss of any adhering trace materials such as fibres, blood flakes, etc.

3. If the exact location of trace evidence (such as hairs, fibres) on clothing or other objects is significant and its presence is obvious, remove and package separately. Note where the material was found. If such material is not removed it may be lost or displaced during transport. Trace material can be secured in place with clear tape, or collected by taping (p.34).

Drying Items

1. Wet clothing, swabs and clothing stained with blood or other body fluids **MUST BE PASSIVELY AIR-DRIED** prior to packaging to prevent decomposition of body fluids. When drying clothing, place a clean paper under each article to collect any particles that may fall off. Fold the paper and submit along with the item.

   Once the items have been dried, they must be individually packaged in paper bags or clear plastic bags as noted under Basic Procedures (p.12). (If air-drying is not possible, consult the Biology staff).

2. Swabs stained with blood or other body fluids must be passively air-dried before packaging. Once dry, samples are very stable and can be held at room temperature for a short period of time before submission. For long term storage, dried swabs should be frozen.

3. When drying items, avoid exposure to excessive heat sources such as radiators, intense sunlight, etc. **DO NOT use a fan or hair dryer to hasten drying.** Air currents may blow trace evidence away.

4. Leather and suede items are difficult to dry completely and should therefore be packaged in paper; **DO NOT package in plastic.**

Cuts, Tears And Other Separations

1. Submit the actual item containing the damage. Preserve all cuts, tears, holes, seam separations, etc. as found. Refer to the section under "COLLECTION AND PACKAGING", p.26 for packaging procedures.

2. Protect any areas of particular interest (e.g. bullet holes, paint smears, etc.) by pinning a sheet of stiff paper over the area before folding.

3. Any instrument suspected of having been used to inflict the damage should be submitted. Package in such a manner as to avoid loss or transfer of trace evidence as described under "COLLECTION AND PACKAGING".

4. DO NOT attempt to fit a suspect instrument into a cut.

5. Make note of any articles of clothing that were cut to facilitate removal by Emergency medical personnel or at autopsy.

   NOTE: The pathologist is the person best able to assess the type of instrument used to inflict a wound and to express an opinion on the compatibility with a particular instrument or object. Stab wounds or cuts in tissue of a deceased **should not** be excised for submission to the Laboratory.

Miscellaneous

1. Note the order and manner in which the clothing was worn. **DO NOT turn the clothing inside out.** If bedding such as sheets, blankets, etc., is submitted, note the original order of placement and orientation of each item on the bed.

2. On items where both fingerprinting and body fluid or hair/fibre analysis are required, Biology staff should be consulted to help assess the order in which the analyses should be done. It is generally better to submit an item before it has been fingerprinted.

3. Formalin **should not** be used to preserve tissue specimens requiring DNA analysis.

4. Any items not accepted at the Laboratory in the original submission should be retained in the event that they may be required at a later date.

Specific Considerations

Bloodstains

a) See "General Considerations" with respect to packaging clothing and fabrics.

b) Ensure that blood stains on objects such as knives, bottles, etc., are dry before packaging. These objects must be packaged so that the blood is retained in its original location and trace evidence is not lost.

c) On items where both fingerprinting and blood analysis are required, Biology staff should be consulted before any fingerprinting is attempted. If an item has already been fingerprinted and, after reconsideration, Biology examinations are required, the item can still be submitted. DNA results can still be obtained; however, the effects of fingerprinting techniques on DNA profiling have not been fully evaluated at this time.

d) Whenever possible, the item bearing the stain should be dried, packaged and submitted. However, sometimes it may not be feasible to submit the actual item. For stains on walls, floors, carpets, furniture and other large or fixed items, use the following procedure:

   i) Photograph the item to show the position and location of the stain. Take a close-up photograph of the stain as its size, shape and appearance may be significant. Be sure to include a scale in all photographs.

   ii) Collect the stain or stained area from the item in the appropriate manner (see details below). For each item, be sure to collect a background or negative control sample. This sample should be an unstained area of the same material collected as close to the stain as practically possible. The area sampled for a negative control should be approximately as large as the stained area.

   For wet stains on a non-absorbent surface use one or more swabs to soak up the blood; concentrate the stain on the tip of the swab. For the negative control, use a water-moistened swab and rub an area of the surface in an unstained region near the stain. Air dry all swabs and place them in separate containers for transport to the Laboratory.

   For wet stains on an absorbent surface use a razor blade or scalpel to cut out the stain. Air-dry the stain before packaging. For the negative control, use a new blade and cut out a sample of the background material from an unstained area in the vicinity of the stain.

   For dry stains on a non-absorbent surface use a scalpel blade to scrape crusted stains from the surface; scrape the flakes into a folded piece of paper and enclose it in an envelope. (It is not possible to obtain a negative control for this type of a sample). For non-crusted smears and stains, use a water-moistened swab to collect the stain, concentrating it on the tip of the swab as much as possible. Collect the negative control in a similar manner from an unstained region in the vicinity of the stain area. Air dry all swabs.

   For dry stains on an absorbent surface collect as described above for wet stains. Collect an appropriate negative control sample.

Note:
Each stain cut-out or swab should be collected and packaged separately. Do not combine separate stains on one swab. Multiple swabs from a single stain should be labelled as a single sample.

A sample of the water used to moisten the swabs is not required and should not be submitted.

Semen Stains and Sexual Assault Evidence Kit Samples

a) The complainant of a sexual assault should be examined as soon as possible by a physician and specimens collected for analysis using a Sexual Assault Evidence Kit (SAEK). For more details on the SAEK and the responsibilities of the physician/nurse and the Police Officer refer to the section on "Sexual Assaults", p.144.

b) All clothing should be collected and packaged as outlined under "General Considerations". Relevant articles of clothing can be examined for the presence of semen (if the history suggests external ejaculation, for example) and for signs of damage (if the history suggests the use of force or a struggle).

c) Items from the scene such as bedding (blankets, sheets, etc.), rugs, couch cushions etc. can be submitted provided that they are relevant to the case. If the scene is the suspect's residence, these types of items are generally not accepted unless there is some reason to believe that blood or body fluids from the complainant may have been deposited on them.

d) If it is not practical to submit an item such as a car seat, mattress, carpet, etc., but a visible stain is evident or the approximate location of the semen deposition is known, cut out the stain or suspect area and submit for examination. Be sure to include an equivalent area of nearby unstained material as a negative control.

e) Used condoms should be packaged in a clean leakproof container or plastic bag and frozen. Submit to the Laboratory as soon as possible.

Note:
All items (including swabs from the SAEK) must be air dried prior to packaging and submitting.

Items not accepted at the Laboratory in the original submission should be retained in the event that they may be required for examination at a later date.

Samples found to be negative for motile sperm by medical staff should still be submitted to the Biology staff for analysis. In some cases, more sensitive techniques available at the Laboratory may detect the presence of semen containing few or no spermatozoa.

Precautions:

i) "Luma lite" or "Woods Lamp" (ultraviolet) examination of surfaces such as clothing, bedding, carpets etc., is not a reliable method of identifying the presence of seminal stains — there are many substances besides semen that will be visualized using ultraviolet light.

ii) Swab samples should be taken using swabs and swab containers from a SAEK; they **should not** be packaged in any type of transport or bacterial culture media.

iii) Motility slide smears **should not** be covered with any type of preservative.

iv) The Laboratory does not perform any tests for sexually transmitted diseases; such requests should be referred to a local hospital. If they are unable to provide the service, a laboratory of the Ministry of Health may be contacted (see Appendix D) for further assistance.

Saliva Deposits

a) Package items such as clothing or bedding as outlined under "General Considerations". If the entire item is too large to be submitted and the location of the stain is known, cut it out with a new scalpel blade or razor blade. An unstained control of approximately the same size should also be submitted.

b) If possible, the item bearing the stain should be submitted. Stains on drinking vessels or bottles should be air-dried and packaged in plastic bags for submission.

If it is not feasible to submit an item because of its size or location, use a water-moistened swab to sample the suspected stain. Be sure to include a negative control.

A water-moistened swab can also be used to collect suspected stains on skin (Eg., bitemarks). Air-dry all swabs before packaging and submitting to the Laboratory.

c) Envelope flaps and stamps should be submitted still affixed to the item in question. DO NOT ATTEMPT TO REMOVE BY STEAMING! Ensure that the item is dry and package it in a resealable (eg., Ziploc™) bag or in another envelope. When sealing the outer container do not moisten it with your own saliva.

d) Cigarette butts should be picked up using forceps or with a gloved hand. Package in a resealable plastic bag and submit.

Items for Hair Examination

a) All clothing should be collected and packaged as outlined under General Considerations.

b) Items such as weapons (knives, hatchets, hammers, etc.) with hairs present should be handled and packaged carefully to minimize trace loss. If the hairs are adhering strongly to the surface they can be left in place and the actual item can be submitted. Be sure to package as described under "Preserving Trace Evidence", p.26.

   If there is a chance that the hairs may be lost in transit, they should be removed and packaged by placing them in a piece of folded paper and sealing this into an envelope (see Fig. 1).

c) For large objects where it may not be practical to submit the actual item, hairs can be removed with clear tape (see Fig. 2) or picked off with gloved fingers and packaged within a folded piece of paper in an envelope (Fig. 1). **Forceps should not be used** except as a last resort as they may damage the hairs.

d) If significant fibres are thought to be present in the hairs, they can be collected by combing the hair with a cotton-packed comb (Fig. 3, p.42).

Items for Fibre Examination

a) All clothing should be collected and packaged as outlined under "COLLECTION AND PACKAGING", p.26. Where fibre examinations may be required, items must be packaged in paper; the use of plastic bags may contribute to the loss of fibre evidence as fibres tend to cling to plastic.

b) For fibres on items such as knives, similar care must be taken as for hairs to package the item in a manner that minimizes the loss of any adhering fibres.

c) If it is not practical to submit the entire item, the fibres or fabric can be removed and submitted, however, see "Precaution" below. Fibres can be collected using clear cellulose tape (see Fig. 2 and refer to the section on "Taping an Area"). Individual fibres should be placed onto clear cellulose tape and submitted in this form. Each sample must be marked as to its specific source. Embedded fibres can be collected using forceps and placed on cellulose tape or in folded paper and sealed in an envelope (Fig.1).

d) If pieces of fabric are being collected, they should be removed as carefully as possible so as not to alter the appearance and/or shape (since they may form a physical match with their source). Pieces of fabric should be placed inside folded paper and sealed in an envelope (Fig.1).

Precaution:

Many fibres are not visible to the naked eye. The use of a "luma lite" or laser is not entirely suitable since not all useful fibres are detected by these instruments. It is generally preferable to submit the entire item or to tape all potentially significant areas on the item.

Taping an Area (Fig. 2)

Use clear transparent tape 24-28 mm (1-1.5 inches) in width. Do not use fingerprint tape (too sticky) or frosted/opaque tape (poor transparency). Fold one end of the tape over about 1 cm to create a small tab to facilitate later handling and then wind the tape around the fingers. Ensure that only surface-adhering fibres are collected by systematically patting lightly, not forcibly, over the surface. More forcible patting can be used if the surface is hard (such as metal). When the surface of the tape is filled, the process can be continued with more pieces of tape.

Taping is complete when enough tapes have been used to completely sample the areas of interest.

Tapes should be placed, sticky side down, on clear plastic sheets. Fingerprint plastic sheets are suitable. Plastic sandwich bags, grocery bags or paper bags ARE NOT SUITABLE. Identify the tapes as to location and place the plastic sheets in envelopes. If there are two or more sheets from one item they can be placed together in one envelope. Sheets from different items must be packaged separately.

Areas adjacent to where the trace fibres are located should also be taped for comparison purposes.

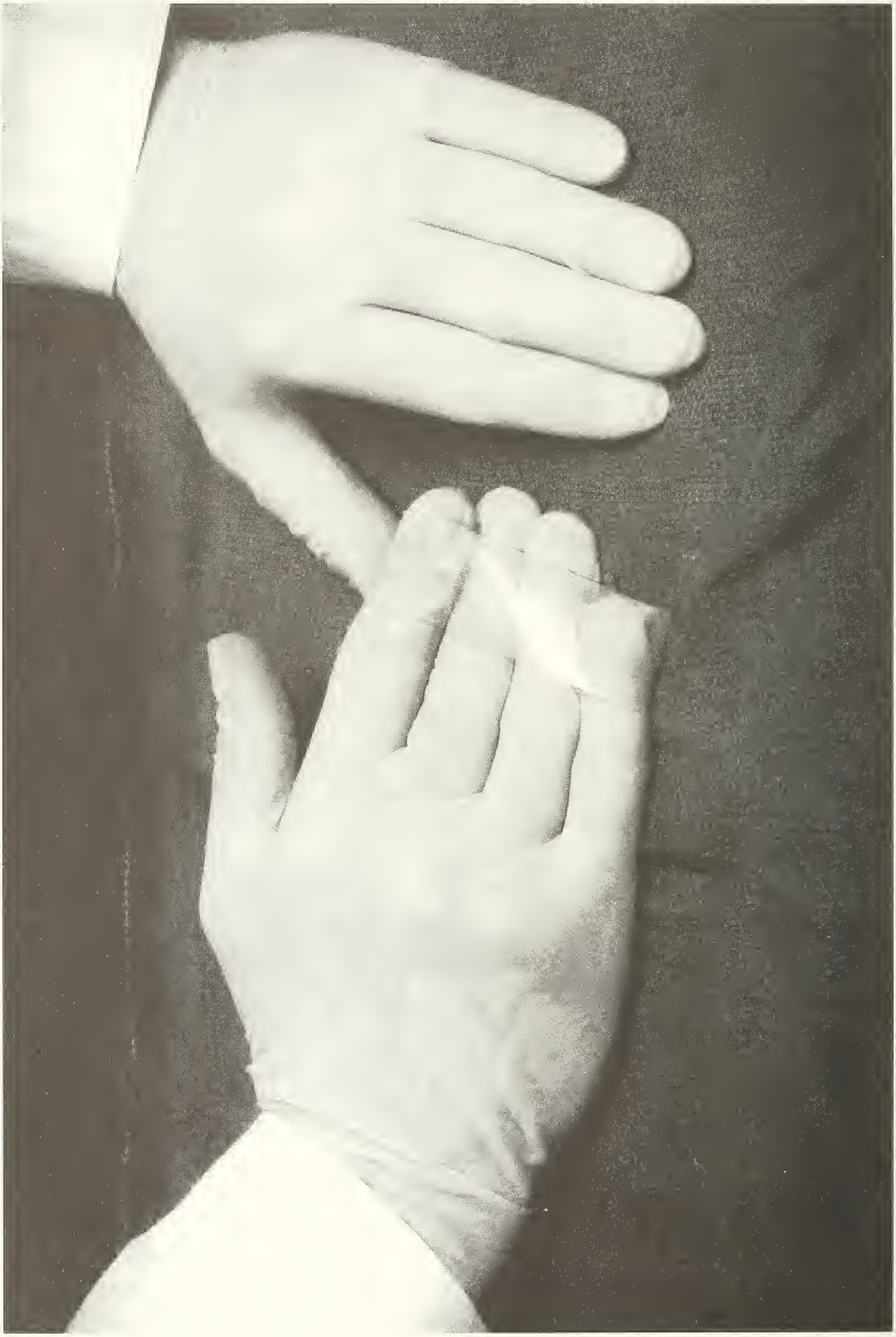


Fig. 2 Taping a surface for foreign hairs and fibres

Botanical Materials

a) Clothing containing botanical fragments should be removed while the wearer stands on a sheet of paper so that any fallen debris can be collected. Each article of clothing along with the folded paper, should be packaged in paper bags as outlined under "COLLECTION AND PACKAGING", p.26.

b) Items such as tools which may have wood slivers or sawdust should be packaged in paper bags and/or boxes to minimize the loss of any adhering material. For example, the working ends of tools, such as pry bars, should be wrapped in paper to form a protective sheath. Saws with wood particles in the teeth should be packaged so as to prevent dislodging and loss of the material.

c) Large pieces of plant material that may be caught under vehicles, for example, should be carefully removed and packaged into paper bags with stiff cardboard or placed into a cardboard box to avoid further damage.

d) Do not package vegetation in plastic bags as this promotes sample deterioration. Any living/non-dry vegetation should be submitted as soon as possible and brought to the attention of the Biology staff so that it can be preserved for later examination.

BLOODSTAIN PATTERN INTERPRETATION

Bloodstain patterns can often be interpreted to provide information about the possible actions causing the patterns. In most cases, properly taken photographs are sufficient for this purpose.

When interpretation of bloodstain patterns is necessary, the investigator in charge should first discuss the matter with an identification officer or scene-of-crime specialist experienced in this field. Where patterns are complex and/or the identification officer or scene-of-crime specialist lacks the necessary training and experience, the Laboratory should be contacted.

Photographing Bloodstain Patterns

Bloodstain pattern interpretation requires high quality photographs which display as much available information as possible. The following section describes the elements necessary for the production of photographs amenable for bloodstain pattern interpretation. Poor quality photographs may reduce the scientist's ability to provide any meaningful interpretation of the observed patterns.

1. All bloodstain patterns which appear to have resulted from a beating, kicking, splashing, wiping, shooting etc., should be photographed in COLOUR and 20 cm x 25 cm (8" x 10") enlargements submitted. If it is not feasible to provide a large number of enlargements, submit smaller photographs or contact prints of ALL photographs. The scientist will then determine which photographs require enlargement.

2. All photographs should be taken at 90 degrees (PERPENDICULAR) to the stained surfaces and include horizontal and vertical METRIC scales.

3. OVERALL photographs of the bloodstained areas on the wall, floor, ceiling etc. should be submitted. These photographs should include a vertical scale extending from a bottom reference point such as the floor and a horizontal scale extending from another reference point such as the edge of a wall or a door frame (Fig.4). If possible, the horizontal reference point should be to the left of the bloodstain pattern.

4. CLOSEUP photographs of bloodstained areas should also be submitted (Fig.5). These photographs must include either a portion of the horizontal or vertical scales or a separate, new scale. If an original scale is moved to appear in the closeup photograph, the starting point should remain at the same reference point used for the overall photograph.

5. Representative stains and control areas to be collected for subsequent laboratory testing must be identified by circling and labelling before photographing (Fig. 4).

6. All submissions of photographs should be accompanied by a SCALE DIAGRAM of the scene, indicating the location of the individual photographs. **In homicide cases, autopsy reports should also be submitted.**

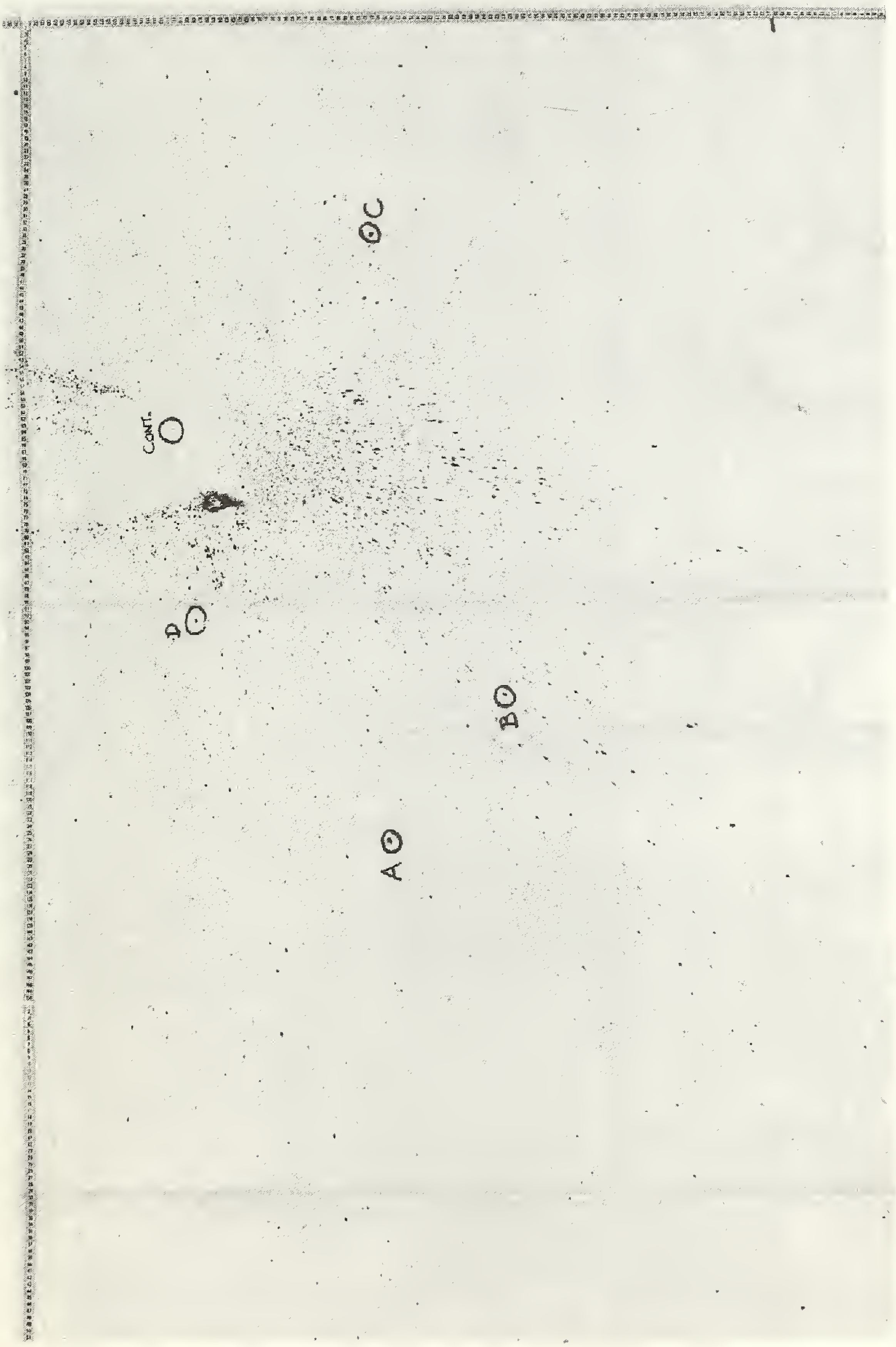


Fig. 4 Overall photograph of a bloodstain pattern

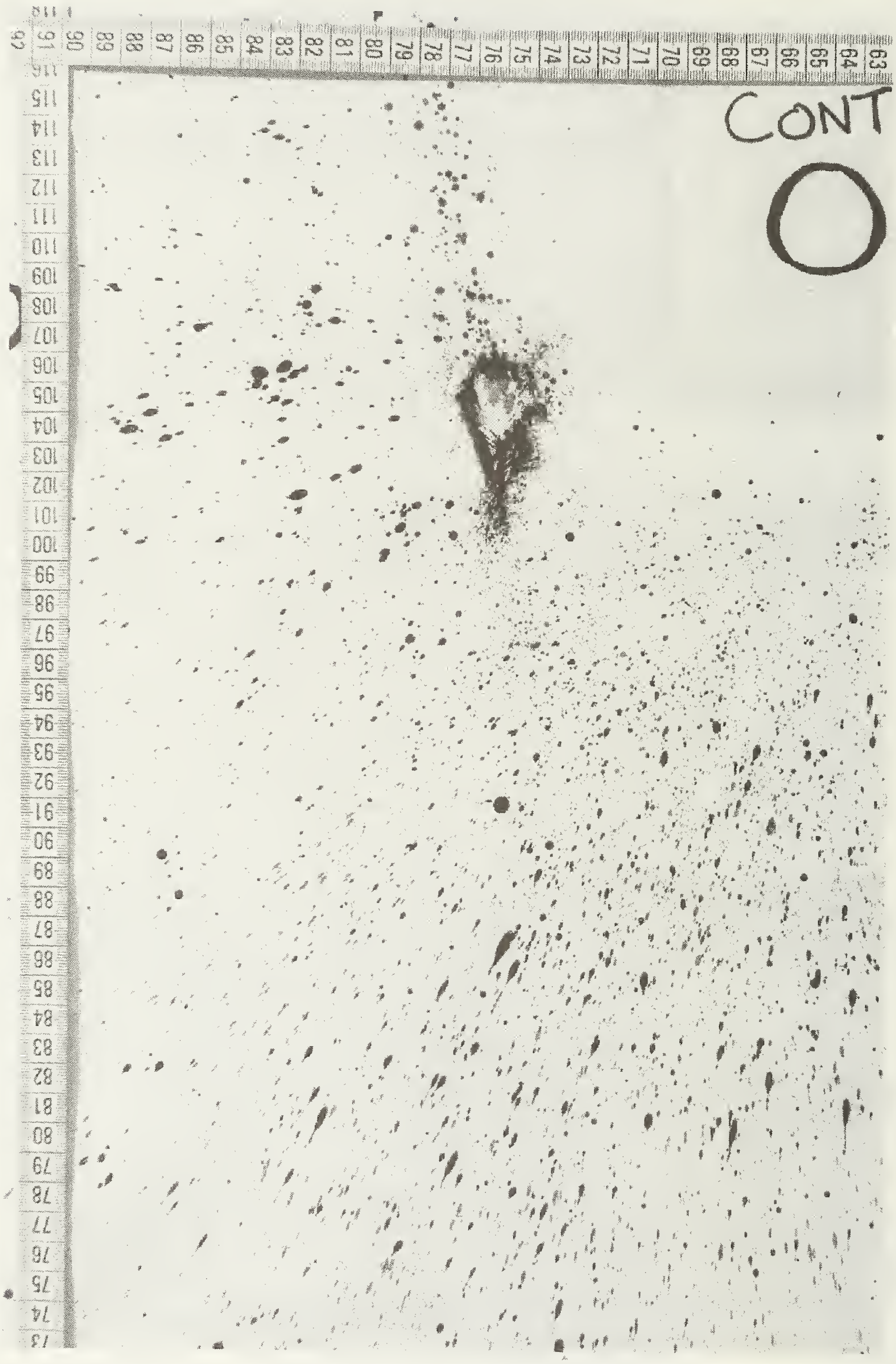


Fig 5 Closeup photograph of a bloodstained area

Particular concerns

(a) Difficulties arise when the scientist does not have all scene photographs. The lack of bloodstains in particular locations of a scene may be very important to the overall interpretation of the scene. Therefore, please submit ALL scene photographs.

(b) VOIDS in bloodstain patterns arise when an item, such as a piece of furniture, blocks some of the projections of blood. In such cases, photographs should be taken of the bloodstain patterns with and without the blocking item in front. Make note of the distance between the blocking item and the blood stained surface behind it.

COMPARISON SAMPLES

General

In addition to identifying the presence of blood or another body fluid, most investigations require assistance with respect to the source of the body fluid in question. Thus, after having collected relevant evidence samples, it is necessary to consider what other samples will be required for comparison purposes. Ideally, comparison samples should be obtained from all parties (and/or objects) involved or thought to be involved in the occurrence.

All attempts should be made to obtain the necessary comparison samples by consent. If certain crucial samples for DNA analysis cannot be obtained by consent, then a DNA Warrant should be sought.

Required Comparison Samples

For cases involving blood evidence, comparison samples from any individual known or thought to be bleeding is required. For sexual assault cases, samples from the suspect/accused and the complainant are the minimum requirement. For elimination purposes, samples are also required from any person with whom the complainant had sexual intercourse (without the use of a condom) within 7 days of the occurrence.

Samples For DNA Analysis

Living Donors

Comparison samples from living donors are described in descending order of preference:

1. Blood Samples

a) Collection by Fingerprick.

Wear Disposable Latex Gloves!!

- Wipe the donor's fingertip with an alcohol pad and allow to dry.
- Hold the donor's hand steady and press just below the target site with your finger. Prick the fingertip quickly with a sterile lancet.
- Have the donor spot the resulting blood drops directly onto clean gauze, kleenex or cotton paper. Collect enough blood to form a continuous stain about the size of a dollar coin (if possible) and allow it to air dry. The resultant bloodstain is stable for long periods of time with little to no effect on subsequent DNA typing.
- Wipe the donor's fingertip with an alcohol pad and apply a bandage.

b) Collection by Venipuncture

Liquid blood samples collected by venipuncture should be taken by qualified medical personnel only. Vacutainer™ tubes containing the preservative EDTA (lilac coloured stopper) should be used. Refrigerate the sample and submit to the Centre as soon after collection as possible; do not freeze the sample. Blood collected in other types of preservatives can still be analysed; however, collection should be in EDTA whenever possible.

TRANSFUSIONS:

If a person has had a recent blood transfusion, a blood sample may not be a suitable comparison sample. If no pre-transfusion blood is available, then an alternative sample (see below) should be submitted.

2. **Pulled Hairs**

   At least 10-15 pulled scalp or pubic hairs with root sheaths **(See Fig.6.)** should be collected and packaged into folded paper and placed in an envelope (Fig.1). Hair fragments cannot be analyzed. **Note:** This sample is not sufficient as a comparison sample for conventional hair analysis (see p.44).

3. **Oral/Buccal Swab**

   Have the donor rinse his/her mouth twice with water to remove any food particles. Then, using a sterile swab, thoroughly swab the inside of the cheek by rubbing up and down 10 times. Air dry the swab before packaging.

4. **Saliva**

   Collect the sample by having the donor expectorate several times on the central area of 2-3 layers of clean paper tissue. Air dry and package in an envelope. The tissue should only be handled by the edges before and after collection.

5. **Atypical Samples**

   In some cases, after consultation with Biology staff, items such as cigarette butts, chewing gum, and drinking utensils including bottles, coffee cups and drinking straws known to come from a suspect have been used as preliminary comparison samples. Other personal items used for this purpose include: toothbrushes, razors, hairbrushes and underwear. Initial results may provide a basis for obtaining a preferred comparison sample by DNA Warrant.

Comparison Samples Obtained by DNA Warrant

In certain types of cases, the DNA Warrant Legislation (Bill C-104) allows investigators to obtain samples from suspects or accused individuals without consent. DNA Warrant samples can only be collected by a police officer or other individual who has been specially trained to collect such samples using a DNA Warrant Sample Collection Kit. These kits are available through the Centre Receiving Office. They are intended for the **collection of DNA Warrant Samples only;** individual agencies must provide their own supplies for the collection of consent comparison samples.

For details regarding the preparation and execution of DNA Warrants, consult the Crown Attorney handling your case or contact staff at the Attorney General's Office who are familiar with these matters.

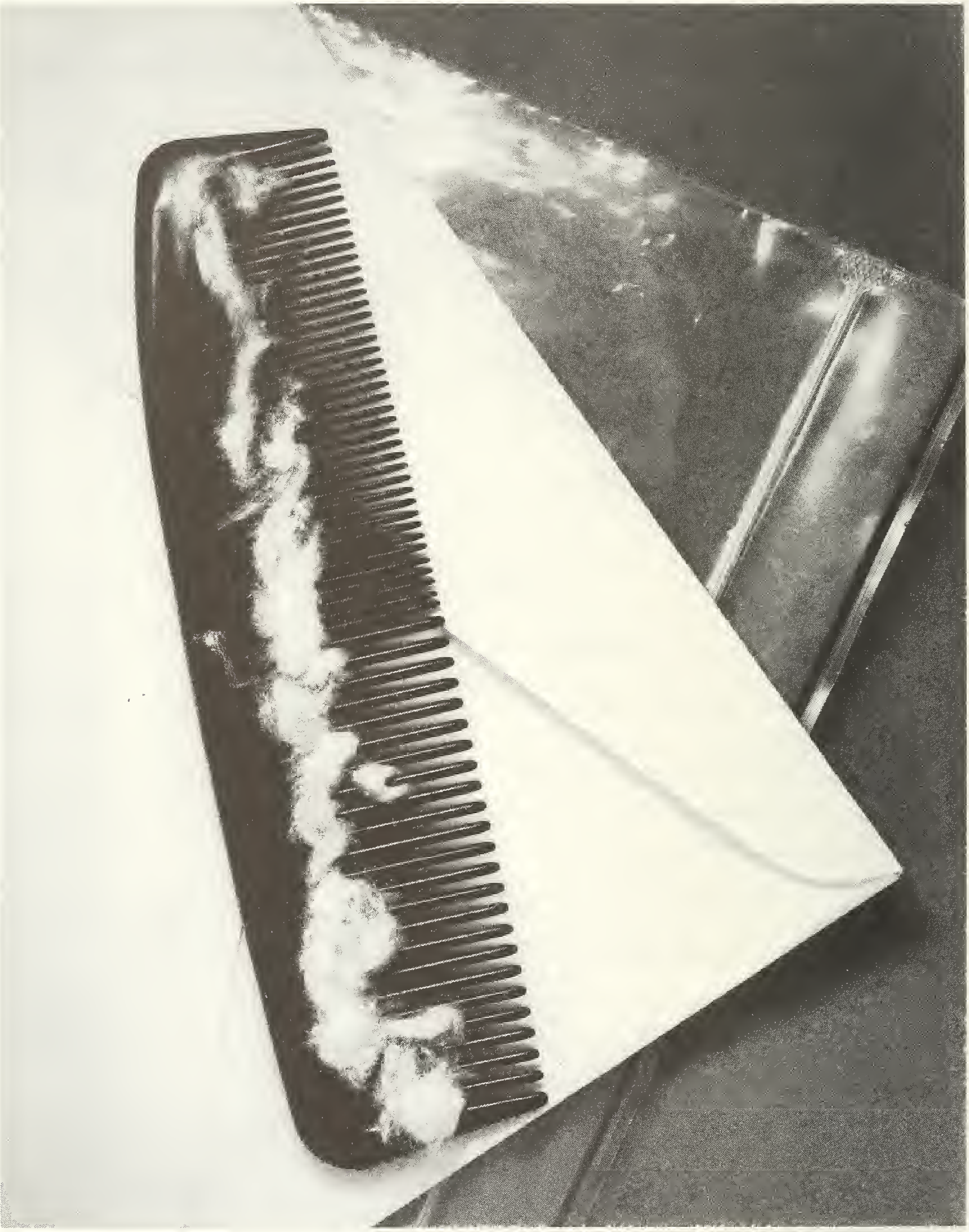


Fig 3 Combing hairs for fibres

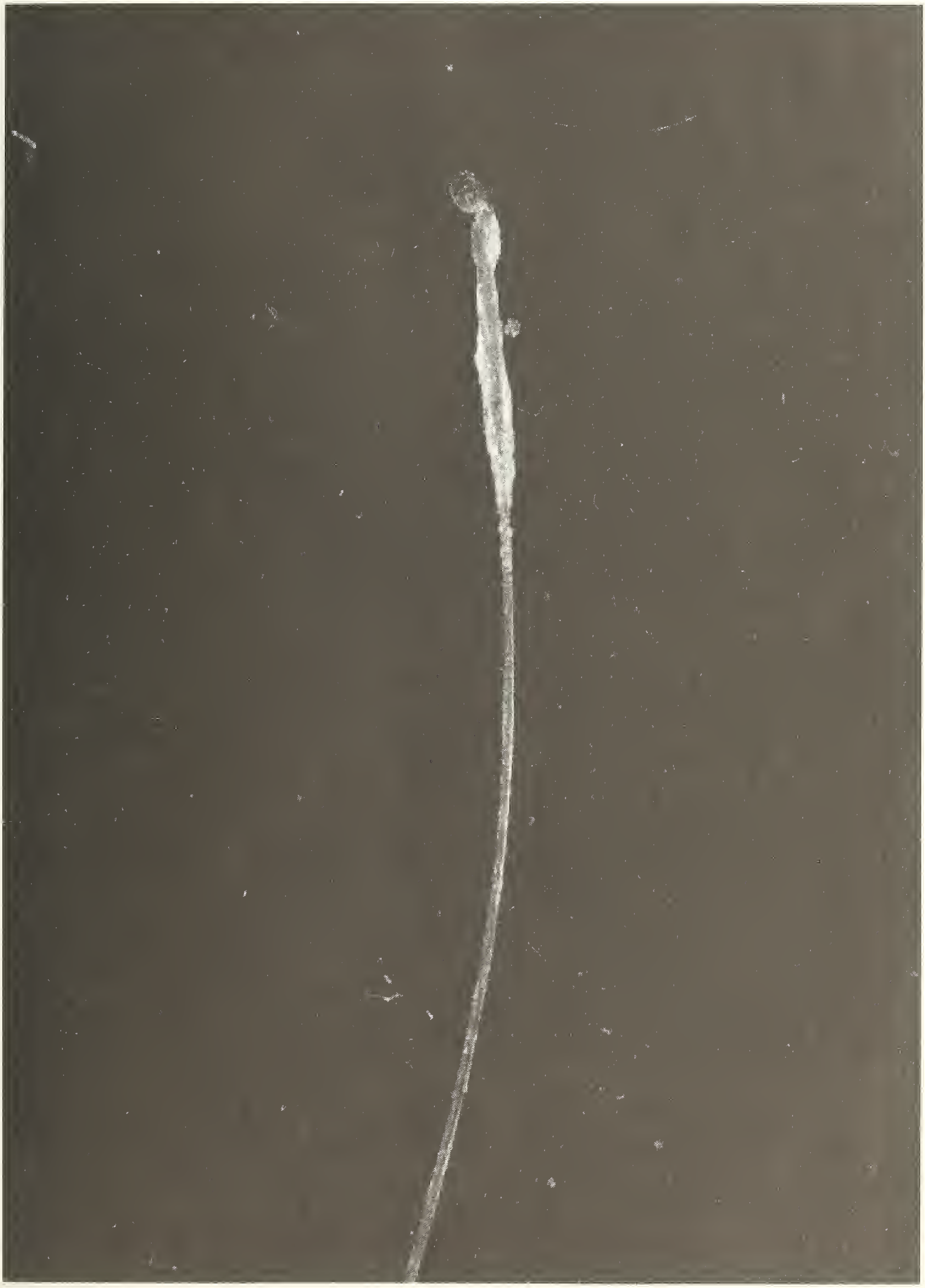


Fig 6 A pulled hair with attached root sheath

Note:
The Legislation requires that samples obtained by DNA warrant be treated in a specific manner during and after analysis. **It is crucial that DNA Warrant samples be clearly indicated as such on CFS Case Submission Forms.**

Samples At Autopsy

The suitability of samples for DNA analysis will depend on the state of the cadaver. If there is little decomposition, samples can be collected according to the guidelines for living donors. With putrefied bodies, one or more of the following samples should be collected as alternatives to blood or hair, depending on the level of decomposition.

a) **Muscle Tissue**

A 2-3 cm (1 inch) cube of deep muscle, preferably from the gluteus maximus or thigh, should be sufficient. The sample should be frozen between collection and submission; **DO NOT PLACE THE TISSUE IN FORMALIN.**

b) **Teeth**

Two to four molars should be extracted. Freeze and submit as soon as possible.

c) **Bone**

Samples from one of the long bones (preferably the femur) should be taken and should include bone marrow. A piece of bone 8-10 cm (3-4 inches) long is sufficient. Freeze the sample and submit to the Centre as soon as possible. **Bone is the most stable source of DNA and will withstand the effects of decomposition longer than other tissues.**

Samples For Conventional Hair Analysis

For the purpose of hair analysis, scalp, pubic and limb hairs may be required as dictated by case-specific circumstances.

1. **Scalp hair**

Approximately 50 to 100 plucked and fallen hairs should be collected from various locations so that the entire scalp is represented (i.e. not from one localized area). Ensure that variations in colour and length are represented.

Have the donor position their head above a piece of brown paper and rub scalp vigorously to collect fallen hairs. A variety of hairs from various areas of the scalp can then be pulled and placed in the piece of paper for submission (Fig.1). Entire hairs including the root should be collected.

At autopsy, the pathologist should pull between 50 to 100 scalp hairs in the manner described above.

2. **Pubic Hair**

   Approximately 25 pubic hairs (combed and/or pulled) should be collected. The hairs should be packaged in folded paper and placed in an envelope (Fig.1).

   Note:
   Prior to collecting the comparison sample, any hairs matted with semen or other secretions should be cut out and collected separately. Any loose foreign hairs, fibres, debris, etc., should be collected with a clean comb (preferably cotton-packed) and submitted separately.

3. **Body Hair**

   A minimum of 12 body hairs such as beard, chest and limb hair (combed and/or pulled) from the areas of interest should be collected and packaged in folded paper and placed in an envelope (Fig.1).

   Where there has been an injury to a particular part of the body, a sample should be collected from the area adjacent to the wound when feasible. Discretion must temper the amount and manner of collection.

Samples For Fibre Analysis

1. All items that could have been involved in a fibre transfer should be submitted. Items for comparison purposes must be packaged separately from case items as outlined under “COLLECTION AND PACKAGING”, p.26.

2. Whenever possible, the entire comparison item (e.g., shirt, blanket) should be submitted.

3. If the comparison item cannot be submitted, an area large enough to provide a representative sample should be cut out and submitted. Samples from different areas of the items may have to be submitted to adequately represent different colours, patterns, and degrees of wear and fading.

Samples For Botanical Analysis

1. **Wood Samples**

   a) Where possible, the damaged section of the wood should be submitted for comparison to any fragments on clothing, tools or other items. If it is not practical to submit the damaged section, wood samples can be removed from relevant areas.

   Consideration should be given to the possibility of a physical match between fragments of the questioned material to the damaged item at the scene.

   b) Woods consisting of more than one component, such as veneers and plywoods, should include a representative sample from each component.

   c) A representative sample of sawdust or shavings used on floors or as insulation should be collected. A small handful is sufficient for comparison and should be packaged in folded paper and placed in an envelope (Fig.1).

2. **Plant Materials**

   Collect a representative sample of plant materials (plants, leaves, seeds, etc.) from the suspected location. Where possible, obtain complete plants including roots.

   Package items carefully as outlined under "Botanical Materials", p.35.

OTHER SUBSTANCES SUITABLE FOR ANALYSIS

Other Bodily Fluids And Substances

1. **Fingernail Clippings and Scrapings**

   ### Significance

   Significant investigative information may be obtained from fingernail clippings if there has been some kind of close, physical contact during which minute amounts of blood, hair and fibres are transferred. DNA profiling can include or exclude an individual as the source of the sample.

Collection and Packaging

Fingernail clippings are preferred. Cut the nails as close to the fingertip as is reasonably possible. If the donor's nails are so short that the nails cannot be comfortably trimmed, material can be collected using the rounded end of a toothpick to scrape out the area under the nail; a separate toothpick should be used for each fingernail. Care must be taken not to break the skin. Collect the clippings or toothpicks bearing scrapings into a piece of folded paper, one for each hand. Place into separate envelopes for submission.

2. Epithelial Cells

Significance

Epithelial cells line the inside of body cavities such as the vagina, rectum and mouth. Penile swabs, used condoms and foreign objects thought to have been inserted vaginally or rectally can be examined for the presence of epithelial cells. DNA typing can include or exclude a particular individual as the source of the cells. Appropriate comparison samples must be submitted.

In some cases, the identification of epithelial cells as being vaginal in origin may be significant. Specific testing can be done, although the relative lack of sensitivity of the test limits its application.

Collection and Packaging

When packaging an item, the area thought to contain epithelial material should be air-dried then covered and secured in an outer container so that any type of rubbing or pressing against the protected area is avoided.

If the item requires other testing such as fingerprinting, the investigator should consult the Biology staff to ascertain the order in which the examinations should be done.

3. Body Tissues

Significance

It is possible to determine whether a tissue sample is of human or animal origin.

Samples determined to be of animal origin can be further classified to the level of family (eg., dog, cat, bird family).

Human tissues can be profiled using DNA techniques for possible identification purposes. Staff at the Centre should be consulted regarding appropriate comparison samples.

Note: Identification of tissue type (eg., liver, muscle, heart) is not done at the Laboratory. The Forensic Pathology Unit of the Office of the Chief Coroner should be contacted for further information.

Collection and Packaging

Tissue samples should be packaged in a clean, leakproof jar or resealable plastic bag and kept frozen until submission to the Laboratory. **DO NOT store in any kind of fixative such as formalin.**

4. Fetal Tissue

Significance

DNA profiling can be done to determine the parentage of a fetus or fetal tissue. These type of cases include sexual assaults where conception has occurred, abandoned infants and self-abortions.

Collection and Packaging

Identification of fetal tissue may be very difficult, especially in the first trimester (up to 12 weeks development). Abortions contain a mixture of tissues from both the mother and the fetus. It is best, therefore, to have a pathologist examine the sample to identify the fetal component. Once identified, the tissue should be packaged in a clean, leakproof jar or resealable plastic bag and kept frozen until submission to the Laboratory. **DO NOT store in any kind of fixative such as formalin.**

5. Urine

Significance

Tests for the detection of urine are requested when it is necessary to corroborate particular aspects of a case or when the presence of urine is the only evidence available.

DNA typing may be attempted on human urine.

Collection and Packaging

Suspected urine stains on clothing, bedding etc., should be air-dried and packaged as outlined in “COLLECTION AND PACKAGING”, p.26.

Liquid samples should be collected in a clean, leakproof container and refrigerated prior to submission to the Laboratory.

6. **Stomach Contents**

Significance

If the deceased is known to have had a specific meal shortly before death stomach contents can be examined to determine whether or not any of the components of that meal are present.

Estimating the state of digestion of food in a stomach should be done by a pathologist.

Semen can sometimes be detected in stomach contents and has been successfully profiled using DNA techniques.

Collection and Packaging

The entire contents of the stomach should be placed in a leakproof glass container (eg., Mason jar) and the volume measured. Keep refrigerated and submit as soon as possible.

7. **Vomitus**

Significance

It may be possible to identify stains as vomitus and to determine the type of food present. DNA typing has been successful even where clean-up of the stain has been attempted.

Semen can sometimes be detected in vomitus stains and has been successfully profiled using DNA techniques.

Collection and Packaging

The item containing the stain should be submitted. If it is impractical to submit the whole item (eg., a carpet), the stain and the surrounding unstained area can be cut out. Stains should be air dried and packaged in paper bags for submission.

8. **Faeces**

Significance

It may be important to identify material as faeces when it is necessary to corroborate particular aspects of a case or when the presence of faeces is the only evidence available. In special circumstances, DNA analysis may be attempted; however, this type of analysis is rarely done.

Collection and Packaging

Stains or deposits should be air-dried and packaged in air-tight containers and submitted to the Laboratory as soon as possible.

9. **Miscellaneous**

Significance

A wide variety of unusual samples have been successfully profiled using DNA typing. These include abandoned substances such as nasal secretions on kleenex, pared cuticles, chewing gum and spittle collected from a sidewalk. Perspiration and sloughed skin cells from hatbands, sandals and clothing worn in close contact to the skin have also been successfully analysed.

Collection and Packaging

Clothing should be collected as outlined under "General Considerations", p.26. Kleenex containing nasal secretions or used to collect liquid saliva should be air-dried and packaged. Pared cuticles should be packaged in a folded piece of paper and placed in an envelope (Fig.1). Chewing gum should be placed in a resealable plastic bag and frozen prior to submission.

ANALYSES NOT PERFORMED AT THE LABORATORY

1. **Maggots**
The examination of fly maggots and eggs from a dead body may be of assistance in estimating the approximate date of death. This type of analysis is coordinated through the Forensic Pathology Unit of the office of the Chief Coroner.

2. **Mitochondrial DNA**
   Mitochondrial DNA analysis has been successfully used in cases where material is very limited (e.g., hairs with no adhering cell material) or where the degraded state of the sample makes it unlikely that results will be obtained by other PCR techniques. Currently (1997), the CFS does not offer this service; staff can be contacted for further information on laboratories that perform this type of testing.

3. **DNA Analysis of Botanical Materials**
   It is possible to determine if plant material such as seeds or flowers came from a specific plant. This type of evidence may place a suspect at a scene. This type of DNA analysis is not done at the CFS. Staff can be contacted for further information on laboratories performing this type of testing.

Other Fibre Related Analyses

1. **Fabric Impressions**

Significance

Fabric impressions may aid in establishing contact of an object with a particular fabric; hit and run cases are one example. Fibres and yarns found in association with fabric impressions may be analysed and compared to establish a possible source.

Collection and Packaging

IF THE ITEM IS BEING SUBMITTED

- Whenever possible, the item bearing the impression should be submitted.
- When packaging the item, cover the area bearing the impression with heavy paper or cardboard. Secure the item so that rubbing or pressing of the protected area is avoided.
- All clothing or fabric items with which the surface could have been in contact should be submitted. See "COLLECTION AND PACKAGING", p.26, for packaging precautions.

IF THE ITEM CANNOT BE SUBMITTED

- Photograph the impression(s) to give both an overall view and close-up orientation. Ensure that any adhering trace evidence is visible in the photos. These photos should include a scale. Submit photographic prints and negatives.

- If yarns and fibres are present, collect by taping (Fig.2) or picking off. When taping for trace fibres on hard surfaces the tapes should be firmly pressed to recover material on or in the surface. Package separately for submission.
- All clothing or fabric items with which the surface could have been in contact should be submitted. See "COLLECTION AND PACKAGING", p.26 for packaging precautions.

2. Ropes, Cordage, Twine and String

Significance

Like other fibrous materials, these objects can be identified and compared based on their composition, construction and colour. Surface markings and inclusions resulting from usage may also be significant. Although comparison of ends does not usually result in physical matches, the nature of the separation (ie., cutting, tearing, burning) may be significant. Existing knots should be left intact as a comparison of knot types may be of some significance.

Collection and Packaging

If there is a piece of material available as a comparison sample it should be submitted. Package all items in paper.

It is important not to remove any surface substances or markings from the item. Protect the ends of the item from damage and ensure that they are properly labelled. If it is necessary to cut the item, the ends should be clearly identified. Do not cut through existing knots.

Buttons and Fasteners

Significance

Buttons and fasteners are not usually made of fibrous material. They are generally compared by their physical appearance rather than their chemical composition. If the fastener is unusual or unique, it will have greater significance than a more common type. The absence of fasteners from their normal place on a garment and the manner in which they were removed (ie., cut, torn) may also be significant. Buttons torn from a garment may retain threads or small pieces of fabric which may form a physical match with the item from which they were removed. Attached fibres are also amenable to fibre analysis.

Collection and Packaging

It is necessary to submit the garment from which the button or fastener was removed for comparison to other fasteners and to examine the original location of the fastener. Items should be packaged according to the guidelines set out under "COLLECTION AND PACKAGING", p.26.

SIGNIFICANCE OF FINDINGS

"When any two objects come in to contact there is always a transference of material from each object onto the other."

Edmund Locard, ca. 1928.

This principle is particularly applicable to cases submitted for biological examination since most biological examinations seek to identify the substance that has been transferred such as blood, semen, hairs and fibres. Once identified, the substance can be classified based on its biological characteristics and compared to known sources in order to identify associations that are potentially of probative value.

DNA Profiling Techniques

Introduction

DNA cases were first accepted at the Centre of Forensic Sciences in 1990. Since then, the DNA unit of the Biology Section has steadily expanded in size and in the services that it provides. In early 1995, conventional grouping was replaced by DNA technologies. The high degree of individualization attainable through DNA analysis was the primary reason for this change. Since no two individuals (with the exception of identical twins) have the same DNA, the results make it possible to include or exclude an individual as the source of a particular sample. A wide variety of sample types, such as blood, semen and saliva, and hair root sheaths can be tested. Because the genetic material is the same in every cell type of any one individual, comparisons can be made using any tissue type or fluid samples. DNA techniques are especially suitable for forensic applications because analysis can be performed on small samples or samples which are old or in poor condition.

Currently, the Biology Section of the Centre uses two DNA profiling methods for the comparison of body fluids, tissues and hair roots. The methods are based on PCR (polymerase chain reaction) technology and RFLP (restriction fragment length polymorphism) analysis.

PCR Analysis

PCR-based analyses work very well with samples which are very small and/or when degraded samples of blood or other body fluids are present. The clear advantage of the PCR technology is that samples which were previously inadequate or unsuitable for further testing can now be profiled and compared to known comparison samples.

PCR profiling is the "workhorse" for most casework comparisons in this Laboratory. The procedure is less labour intensive than other techniques and results are often available within a few weeks.

Currently (1997), the Laboratory is equipped to profile 10 loci or genetic locations using PCR-based analysis. The loci fall into 2 categories: sequence polymorphisms such as DQA1 and Polymarker, and length polymorphisms such as short tandem repeats (STR). It is anticipated that the number of loci which can be analysed will increase as new systems are developed and validated. As the number of loci increases the frequency of occurrence will decrease allowing for actual **individualization** of a given sample.

The number of loci that will be profiled will be determined by the scientist based on case-specific requirements.

RFLP Analysis

RFLP-based analysis was the first form of DNA analysis used at the Centre, beginning in 1990. It has been successfully used in many cases. Its advantage is its ability to produce a very high degree of individualization while examining only a small number of loci. However the RFLP procedure has been steadily replaced by PCR technologies because RFLP analysis is labour intensive and lengthy, generally requiring a minimum of 12 weeks to complete. RFLP is still used in homicides or suspected homicides where there is no body, but blood or body tissue is found. In these cases, a "reverse paternity" analysis can be done using samples from biological family members of the suspected victim. Similarly, RFLP analysis is used for direct paternity testing in criminal cases such as sexual assaults where conception has occurred, or where abandoned infants or self-abortions are involved.

Blood

Identification

Relevant stains are analysed for the presence of blood using a sensitive chemical indicator test. A positive result is a strong indication that the stain is blood. Stains that are in poor condition due to age, environmental insult or actions such as washing or dry cleaning may still be identified using this test and successfully profiled using DNA techniques.

The age of a bloodstain cannot be accurately determined.

Testing for menstrual blood is no longer available.

Species Determination

Bloodstains can be tested to determine whether they are of human or animal origin.

Where there is no reason to suspect a non-human source, species determination is not attempted. In the course of DNA testing, the blood is confirmed to be of human origin.

Testing for species determination is done in cases where there is some doubt about the source, for example, in a hit and run accident where collision with an animal is a plausible explanation for the presence of bloodstains. If testing shows the blood to be non-human, further analysis can be done to establish the animal source to the level of family (eg., dog family which includes domestic dogs, wolves and foxes). While it is possible to determine if blood came from a specific animal, this kind of testing is not done at the Laboratory (see Appendix D for agencies that test animal bloods).

Bloodstain Pattern Interpretation

The analysis of bloodstain patterns at a scene, on weapons and clothing may provide information about the possible actions causing the patterns. It may be possible to determine:

1. The type of impact or action causing the pattern.
2. The direction from which the blood originated and the origin of the projection.
3. The position(s)and location(s) of the involved persons.
4. The sequence of events which resulted in the patterns.

Semen

Semen is only produced by males. Spermatozoa are the major cellular component of semen, and their presence indisputably identifies a stain or liquid as semen. Semen lacking spermatozoa due to vasectomy or a medical condition can still be identified by other male-specific factors.

Spermatozoa are quite resilient cells. While sperm motility (movement) may only last for approximately 3-6 hours after ejaculation in the vagina of a living female, the cells themselves can still be detected for up to 6 days. Orally, sperm may survive for approximately 13 hours; anally and rectally, approximately 46 and 65 hours, respectively.

Semen and its cellular components are also very stable in dried stain form. Spermatozoa may survive removal procedures such as laundering or dry cleaning. Stains on items of clothing or bedding cannot be definitively aged. In some cases it may be possible to conclude that a stain was deposited since the item was last washed, based on the seminal constituents present. A more definite time period cannot be stated.

DNA profiling can be done on samples containing semen to include or exclude a particular male individual as the possible source of the semen. Even individuals with low or absent sperm (i.e., vasectomized) levels may be successfully profiled.

Samples taken from body cavities generally consist of body fluid mixtures (ie., semen from the male, vaginal secretions from the female). Therefore, comparison samples from the complainant and the suspect must be submitted. Due to the longevity of sperm cells, it is necessary to obtain comparison samples from any sexual partner of the complainant from the 7 days preceding examination.

Saliva

Identification of saliva is based on the detection of high levels of amylase. This chemical is not unique to saliva and may be detectable in other body fluids. Therefore, interpretation of results may be dependent on the location of the stain and the presence of other body fluids.

The individualisation of saliva using DNA techniques can play an important role in an wide variety of cases. For example, saliva found on a discarded mask may be used to link a suspect to a robbery. Saliva on drinking utensils or cigarette butts may place an individual at a scene. In sexual assault cases, the identification of saliva may help to corroborate a complainant's allegation of cunnilingus or fellatio. Saliva can also be recovered from bitemarks and from stamps and envelopes used to send letters in hate crimes or stalkings. Sensitive DNA techniques can be used to profile these small amounts of saliva.

Hairs

Physical Comparison

Hairs can be evaluated based on characteristics such as the colour, degree of curl, length and microscopic appearance. The hairs can be ascertained to be of human or animal origin.

a) **Human Hairs**

If the hairs are of human origin, it may be possible to determine the following:

i) racial origin (Negroid, Caucasian, Oriental)

ii) the area of the body where the hair originates (scalp, pubic, body)

iii) damage caused by cutting, burning or crushing

iv) whether the hair has been forcibly removed (pulled) or has fallen out naturally.

Chemical treatment such as bleaching, perming or dying is usually detectable and may provide additional distinguishing characteristics.

Generally, more meaningful information can be derived from scalp or pubic hairs than from other body hairs. Hairs from different areas of the body cannot be compared to each other, ie., beard hairs cannot be compared to scalp hairs nor pubic hair with scalp hairs.

While it is possible to establish that a particular hair did **not** come from a particular individual, it cannot be conclusively stated that a hair came from a specific individual.

b) **Animal Hairs**

Animal hairs can usually be identified to the level of the family of origin e.g., cat or dog family.

Animal hairs cannot be definitely related to a particular cat, dog etc., only that it is consistent with coming from a given animal. It may be possible to establish that the hair did not originate from a specific individual animal.

In cases where the hair is thought to have originated from a garment such as a fur coat, it may be possible to include or exclude a hair as having originated from a particular garment.

DNA Analysis

DNA techniques can be used to analyse human hairs only if some cellular material remains attached to the hair root (root sheaths). In cases where there is no adhering cellular material and the individualization of the hairs is crucial to the case, the mitochondrial DNA of the hair root can be examined. These tests are **not** available at the Centre at this time. Contact the Biology staff for further information on laboratories that conduct these analyses.

Fibres

Each day, an individual comes in contact with a wide variety of textiles found in items such as clothing, bedding, carpeting and furniture. The transfer of fibres that make up these materials may help to establish a relationship between two or more individuals or between a person and either a crime scene or an object.

Fibre types are identified by their physical and chemical characteristics. Based on these properties, fibres can be broadly classified as naturally occurring (eg. wool, silk, cotton) or man-made (e.g., nylon, polyester). Further classification may be possible especially with the man-made fibres even to the level of a specific brand of textile.

Comparisons between fibres of known origin (i.e., a comparison sample) and questioned fibres are made based on colour, composition and construction. A single fibre of common occurrence between persons or objects may be of little value. Finding a number of fibres or yarns that share particular characteristics may be a strong indication of contact with a garment containing these fibres or yarns. Different types of construction (tweed, corduroy etc) and other unique distinguishing features increase the number of identifiable characteristics and add to the value of fibre evidence.

Studies have shown that transferred fibres are lost very rapidly. Thus, failure to find some evidence of transfer does not negate the possibility of contact.

Botanical Materials

Wood and plants are the chief areas of interest for botanical examinations.

Wood

Wood examinations compare wood fragments in order to link a person or tool to a particular scene. For example, a comparison of wood fragments found on a crowbar to a wooden door frame may place that tool and potentially a suspect at the site of a break and enter. Sawed-off firearms found at the scene may be linked to a suspect's residence by a piece of wood or sawdust that is of the same wood type or physical structure as the suspect firearm.

Fragments of wood can be classified as hardwood or softwood. Frequently, the genus (eg., spruce, maple) and in some cases the species can be determined. Physical structure may also be compared. The size and condition of the sample will determine the extent of analysis that can be performed.

Plant Material

Plant fragments, seeds, burrs, and leaves present on clothing or other articles may be useful in establishing contact with vegetation at a scene. Grain products from feed mills and barns can also be identified and compared.

Depending on the size and/or nature of plant fragments, they may be identifiable as to species. If two or more plant types are being found concurrently on items or the plant is unusual or confined to a specific location or habitat, the value of the evidence increases.

Since very little meaningful information about their source can be derived from the examination of blades of grass or plant stains, these types of examinations are not done.

CHEMISTRY

CFS	**-**	**PHONE**	**(416) 314-3131**
		FAX	**(416) 314-3225**
NRFL	**-**	**PHONE**	**(705) 945-6550**
		FAX	**(705) 945-6569**

The services provided include:

1. Physical and/or chemical analysis of materials such as paint, glass, gunshot residue on hands, fire debris for flammable liquids, explosives, etc.
2. Soil and mineral analysis.
3. Metallurgical and mechanical testing of broken or faulty parts in motor vehicle, industrial and other accidents.
4. Restoration of obliterated serial numbers (other than on firearms).
5. Examination of evidence obtained at motor vehicle collision scenes.
6. Determination of vehicle speed from skid marks and other data.
7. Examination of damaged tires to determine the cause of damage.
8. Examination of automobile lamps to determine if they were “on” or “off” at the time of a collision.
9. Examination of electrical and electronic equipment.
10. Voice identification.
11. Examination of magnetic recordings.
12. Examination of evidence at and from the scene(s) of fires and explosions.
13. Examination of gaming machines.

PAINT

Paint is extensively used as a protective and decorative coating on many surfaces. The wide variation in colour, formulation and usage allows paint to be of good evidential value. Paint can be transferred on impact to a victim's clothing or to tools used in committing a crime.

Collection and Packaging

1. Package small chips of paint as in Fig. 1. Never place them directly in an envelope or plastic bag. DO NOT USE TAPE FOR LIFTING PAINT since the adhesive interferes with the analysis. Large paint chips which may physically fit a damaged area should be packaged securely to prevent fragmentation and to protect edges.

2. If foreign paint is deposited on a car as discrete chips, remove and package the chips.

3. If foreign paint is transferred in smear form to another painted surface, remove the underlying paint together with the smear of foreign paint using a sharp knife or scalpel blade. If the smear is on a metallic surface such as a bumper, remove it by scraping with a sharp blade.

4. Whenever foreign paint cannot be removed without alteration, submit the item bearing it (bumper, piece of fender, etc.). Protect the evidence area from contamination and loss by taping a sheet of paper or plastic over it.

5. To remove paint from a vertical surface such as the side of a car or a doorframe, tape one edge of a sheet of clean white paper below the sample area; fold the lower edge of the sheet upward to within 1 cm (one-half inch) of the taped edge and move the outer edges slightly towards the centre of the sheet. When the outer edges are taped, a pocket is formed as shown in Fig. 7. Use a sharp blade to collect the sample, remove the sheet, package as shown in Fig. 1.

6. Items of clothing should be carefully handled, allowed to air-dry and packaged individually. See "COLLECTION AND PACKAGING", p.26.

7. Submit small items such as tools without attempting to remove the paint. Protect the ends of prying tools with heavy paper or cardboard and package in a plastic bag to prevent loss or contamination of paint deposits.

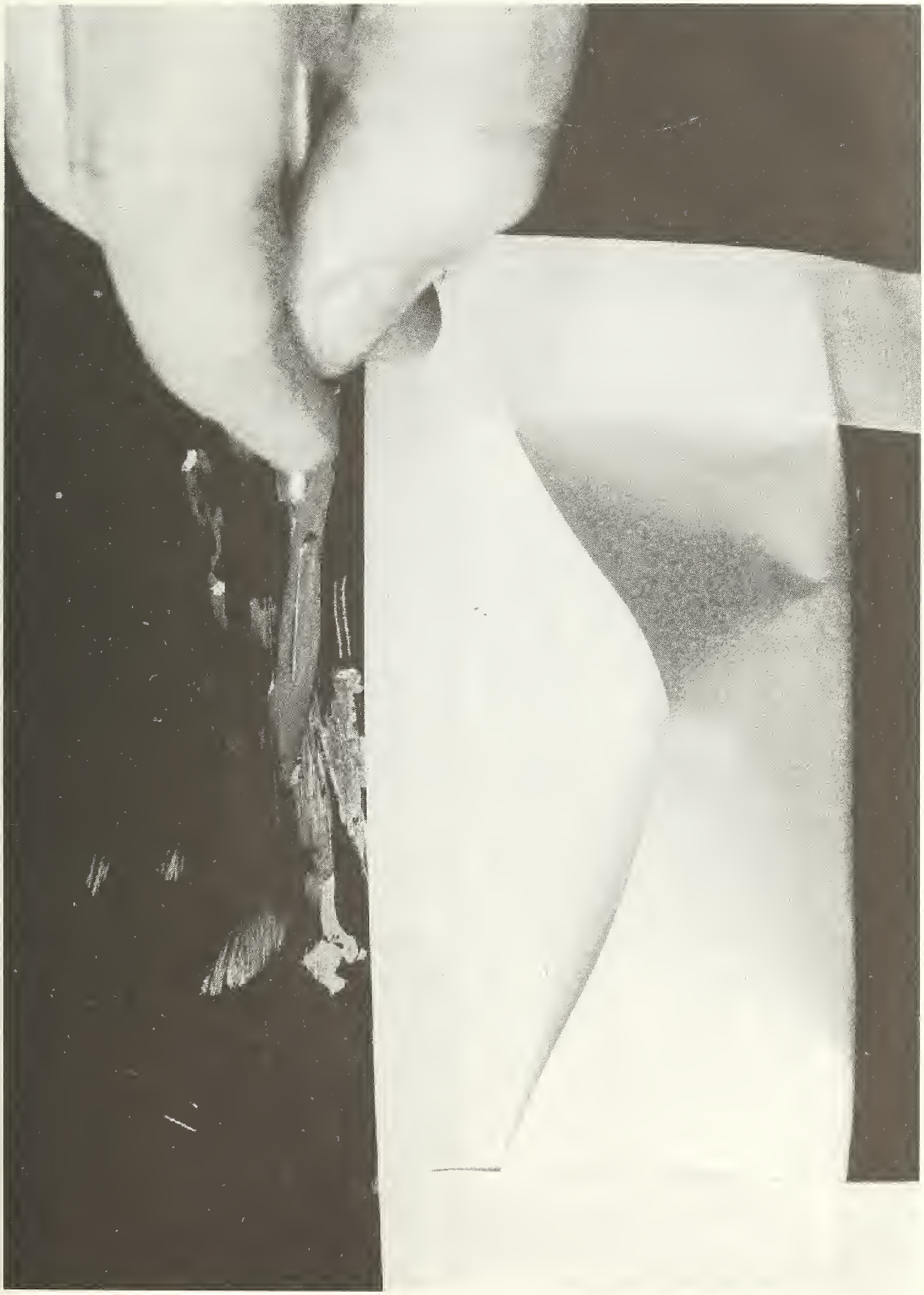


Fig. 7 Collecting paint or other dry material from a vertical surface

Comparison Samples

1. Obtain samples from the immediate area(s) of damage. Use a sharp knife or scalpel to remove chips with all layers down to the unpainted surface. Take samples from all areas where damage has occurred and package each separately.

2. Pieces of body filler and badly rusted metal are sometimes knocked off a vehicle from areas other than the point of impact. Look for such areas on a suspect vehicle and collect appropriate samples.

3. If the paint is on a fixed object such as a door frame, cut out a section including the damaged area.

Significance of Findings

1. Chips or smears of automobile paint can determine the specific colour of a vehicle. If all the original layers of paint are present it is often possible to establish the manufacturer, and a range of models and years for the suspect vehicle.

2. Chips of paint or body filler can occasionally be physically matched to a specific vehicle.

3. Multi-layered chips of paint can be related to a specific source with increased certainty.

4. Smears or very small chips can provide an indication of contact between two objects, eg. pry bar and safe.

5. A double transfer of paint (i.e. from each to the other) between two objects provides stronger evidence of contact than does a single transfer.

GLASS

Although glass is a common material, glass particles of identifiable size are not ordinarily found on clothing and may, therefore, provide useful evidence. When a window is smashed, small particles of glass fly backward on to the clothing of the person breaking the window. These particles which are typically flat and conchoidal (shell-shaped), are not readily dislodged from clothing. Glass particles are sometimes present on tools that have been used to smash windows.

Collection and Packaging

1. Have the suspect stand on a large sheet of clean paper while the clothing is removed. Do not attempt to remove glass particles from the clothing.
2. Items of clothing should be carefully handled, allowed to air dry when necessary and packaged individually.
3. Small fragments of glass may lodge in scalp hair; comb the hair over a clean piece of paper.
4. Place loose particles of glass, such as may be present at the scene of a motor vehicle collision, in a plastic box or vial with a tightly fitting lid. Glass fragments should not be packaged directly in envelopes; they may easily be lost through the seam openings.
5. Where a physical match of larger pieces of glass may be possible, the edges of the glass must be protected during transportation. Wrap the individual pieces separately in absorbent cotton or soft tissue and cushion them within a rigid container using a soft material such as styrofoam or foam rubber.
6. If it is necessary to determine the side from which a window was broken, secure any glass remaining in the frame with tape, mark the side as inside or outside and submit the entire frame if practical. For very large windows contact the Chemistry section. If no glass remains in the window, all of the glass available should be collected from the ground and submitted.

Comparison Materials

1. Obtain a sample of the glass remaining in the door, window etc., a separate sample for each pane broken and package separately. If the broken pane is large (eg. a storefront) and the area of breakage exceeds 1 metre across, obtain several samples representative of the damaged area. Package and label each separately. Try to include a piece of glass adjacent to the frame showing the colour of paint on the putty and/or frame. Two square centimetres of glass are sufficient, unless there is reason to believe that glass may be more than 20 years old. Since older glass may not be a uniform material, collect 5 or 6 separate pieces from different areas of older broken windows.
2. If there are other broken glass objects (bottles, tumblers etc.) at the scene, submit samples from them also.
3. Where a physical match may be possible, such as with a broken headlamp, it is important that all available broken glass be submitted.

Significance of Findings

1. It is usually possible to distinguish between different types of glass eg. soda-lime, borosilicate or optical. However, windows (house and automobile), bottles and inexpensive tableware are normally made of soda-lime glass and may sometimes have similar properties.

2. The source of glass can be positively identified if a physical match can be found between questioned and known pieces. It is important to note that the striations which are always present on the broken edges of a glass chip sometimes enable a physical match to be made between two glass chips with a short common edge. Pieces without a common edge can occasionally be related by specialized photographic techniques.

3. Because the number of manufacturers of windows and bottles is small and they produce a very uniform product, some kinds of glass are relatively common. However, records kept at the Centre for a number of years enable an assessment to be made of how distinctive the glass is in each case. Glass fragments can thus provide useful corroborative evidence.

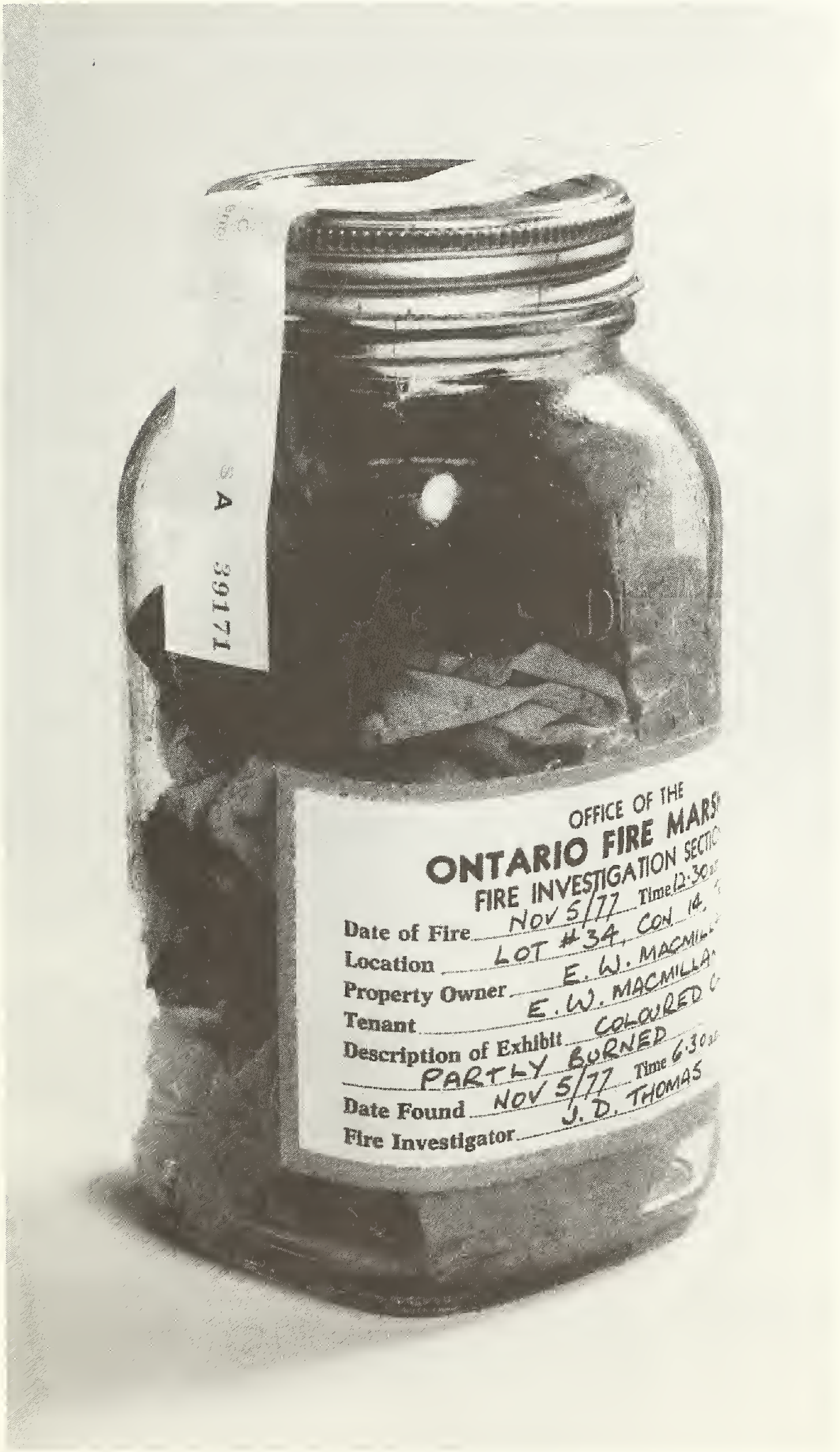
4. Tempered glass (e.g. automobile side and rear windows) can usually be distinguished from non-tempered.

5. It is possible to determine whether a window was broken from inside or outside if a radial crack (one radiating outward from the impact point) can be identified and if it is known which side of the glass was inside as it was installed.

FLAMMABLE LIQUIDS

Collection and Packaging

1. The recommended container for fire debris (see Fig. 8) is a glass jar of about 1 litre capacity (e.g. mason jar). Fill jars to not more than 3/4 full. For very large items consider reducing the sample size by selectively removing those areas suspected of containing flammable liquid, in order that the sample can be placed into the recommended container, a larger glass jar or a clean paint can. If this cannot be done, place the items in nylon bags which are impervious to vapours of petroleum products. These bags are available from Fire Marshal's Office investigators and from the Centre of Forensic Sciences.



OFFICE OF THE
ONTARIO FIRE MARS
FIRE INVESTIGATION SECTI
Date of Fire NOV 5/77 Time 12:30
Location LOT #34, CON 14,
Property Owner E. W. MACMILL
Tenant E. W. MACMILLA
Description of Exhibit COLOURED
PARTLY BURNED
Date Found NOV 5/77 Time 6:30
Fire Investigator J. D. THOMAS

Fig 8 Properly packaged sample suspected of containing volatile liquid

Package carefully to prevent puncture or tear.

Common polyethylene bags (eg. garbage bags) are not suitable containers. If alcohols are suspected as accelerants, use only glass jars or paint cans as containers.

2. Collect samples of debris which exhibit odours suspected to be accelerants. Even where odours cannot be detected, collect samples from what is believed to be the area or areas of origin of the fire, particularly from areas displaying a suspicious burn pattern.

   Where the sample is largely soil, bacterial action can alter traces of petroleum products present. For this reason, such samples should be kept refrigerated.

3. Containers found at the fire scene which may have been used to contain flammable liquids should be closed with a screw cap or tightly fitting stopper, then placed in a nylon bag. Submit as soon as possible. Where large quantities of liquid remain in a container, remove and submit only a small sample (10 mL), retain the rest in the event further testing is required. Supply information from any labels on the container. Place the sample in a suitable glass jar ensuring that the liquid does not affect the seal resulting in loss of the sample and/or contamination. Leakage of flammable liquids can create a hazardous situation. DO NOT use plastic containers e.g. tubes supplied by the CFS for the collection of blood samples.

   Note: Shipping of some fire related items (eg. gasoline) may be governed by the Transportation of Dangerous Goods Regulations.

4. Clothing to be examined for traces of flammable liquids must be packaged separately from all other items to avoid any possibility of cross-contamination. Package as soon as possible preferably in nylon bags supplied by the CFS. If wet, package as such - DO NOT AIR DRY.

   Note: DO NOT use polyethylene bags (eg. garbage bags) for packaging bulky items since these bags are not impervious to vapours of petroleum products. Trace amounts of gasoline, for example, will be lost and higher concentrations may diffuse out of the bag and may contaminate other items stored in close proximity.

5. Lung tissue from autopsy of fire victims (see page 128).

Comparison Samples

1. Containers, liquids, rags, etc. in possession of or available to a suspect should be submitted for possible comparison with materials found at the scene of a fire. Package liquid samples separately from other samples.

2. Samples of synthetic materials (eg. carpeting and padding, floor tiles etc.) remote from the area of burning are required for comparison tests in the Laboratory. (Products from the burning of synthetic materials may interfere with the identification of trace levels of petroleum products).

3. Samples of all materials used to collect an evidence sample (eg. paper towelling, swabs, etc.)

Significance of Findings

Accelerants such as petroleum products can often be identified in burned debris even when they are highly evaporated and present at low concentrations. Because of the high sensitivity of the laboratory instrumentation, it is essential that strict precautions be taken to avoid contamination, both while collecting samples for submission and in packaging them. It is also important to note that the laboratory examination may be necessarily limited by the fact that some potential accelerants, such as turpentine, may be naturally present in some burned debris.

GASES

Collection and Packaging

1. One of the simplest ways to collect a gas or vapour sample is to take a jar or bottle full of water into the area where gas is suspected, pour the water from the container and immediately seal securely.

2. Vacuum gas sampling bottles may be used if they are available.

Significance of Findings

1. The gas or vapour can be identified as natural gas, propane, acetylene, gasoline etc.

2. The identification of gas or vapour may help to establish whether a fire was accidental or incendiary.

EXPLOSIVES

The services of the Centre of Forensic Sciences are available for the analysis of homemade or commercial explosives or explosive devices. Small representative samples should be forwarded after prior consultation with the Centre.

Explosives or objects suspected of containing explosives should only be handled by persons experienced with them. Experienced assistance should be requested from the nearest police or military explosives disposal unit or from the Centre of Forensic Sciences.

Collection and Packaging

1. Samples should be placed in clean glass containers. Report any commercial product names given on the label and include a piece of the wrapper (with label) when appropriate.

2. Deliver these samples by hand to the Centre during business hours. The submission form must state whether the sample is to be picked up by the investigator or destroyed by the Centre upon completion of the analysis.

Significance of Findings

The identity of the major constituents will be reported. An opinion as to the possible explosive nature of the material will be given.

POST BLAST ANALYSIS

The analysis of post blast evidence is usually much more challenging than the identification of unexploded material.

Collection and Packaging

1. Where gas or vapour is suspected, collect an air sample as quickly as possible as outlined under GASES. If subsequent investigation indicates the use of a high explosive or propellant, do not submit these air samples.

2. Collect any remains of containers, wires, burned fuses or possible mechanisms from the device. It is permissible to combine similar items in a common container.

3. If a crater or seat of the explosion is identified, collect separate samples of debris from within the crater and from around the edge of the crater. Collect a comparison sample away from the seat of the explosion.
4. Submit a set of photographs of the scene.

Significance of Findings

Recovered fragments of the device will help in its reconstruction or may be linked to a suspect by comparison with other materials.

Chemical residues may identify the explosive.

PLASTER, CONCRETE, MORTAR AND SAFE INSULATION

Most building plasters and safe insulations have similar gypsum-based chemical composition with the latter often having inclusions of mica, asbestos, sawdust or animal hairs. Wall plasters often consist of several layers of varying texture. Concrete and mortar consist of Portland cement and sand plus aggregate materials.

Collection and Packaging

1. Do not attempt to remove these materials from clothing or tools where it is practical to submit the item.
2. Have the suspect remove the clothing while standing on a large sheet of paper. See “General Considerations”, p.26, for proper packaging.
3. Package small loose particles in small containers having tightly fitting lids.
4. **Do not crush these materials** and thus destroy the physical detail.

Comparison Samples

1. Obtain representative samples from the damaged areas of the wall, safe etc. Approximately 50 grams is an adequate sample.
2. Package in leak-proof containers.

Significance of Findings

1. Wall plaster or concrete with several layers of paint provides useful evidence.
2. Particles of concrete or plaster without unusual physical characteristics provide corroborative evidence only. This evidence may be of value because of the circumstances under which it is found rather than for its composition, i.e most persons do not have particles of plaster or concrete on their clothing.
3. Safe insulations are sometimes characteristic of the manufacturer. They are, in most cases, readily distinguished from wall plasters.

PLASTICS AND RESINS

Plastics and resins are widely used in the manufacture of industrial and household materials. Some of the materials encountered in investigations are plastic bags, sheets and containers, packaging foam, wrapping film, wire coating, piping and toys.

Collection and Packaging

1. Where a chemical analysis only is required, the material should be placed in a clean box, bag or vial.
2. Where a physical match of broken pieces of plastic is possible, protect the broken edges and place in a rigid box.
3. Do not use adhesive tape to collect particles of plastic as the adhesive will interfere with the analysis.

Comparison Samples

1. The remaining portions of items from which questioned samples are suspected to have come should be submitted.
2. Where the questioned sample is intact, submit a similar item, if available.

Significance of Findings

1. Pieces of plastic can be physically matched.
2. It is possible to determine the type of plastic by chemical analysis.
3. The size or shape may indicate a possible origin.

GUNSHOT RESIDUE ANALYSIS

General Information

Gunshot residue (GSR) is the term applied to the minute particles of metal and metal compounds that condense from the ball of hot gases emitted by a gun during firing. These particles are deposited on the surfaces of the weapon, on the hands and clothing of the shooter, or on other nearby surfaces. The hand sampling kit is designed to collect these particles from the web and back of the hand so that they can be located for identification and analysis using the scanning electron microscope (SEM). Because the particles are rounded and not sticky, they are rapidly lost from the hands as a result of normal activity; thus, to be useful, the collection of the samples for GSR analysis must be given a high priority.

GSR ON THE HANDS

Collection and Packaging

Gunshot residue collection kits are provided to law enforcement personnel by the CFS. Each kit contains a set of instructions for its use. See Appendix B for a copy of the instructions and the questionnaire placed in each kit for the user to complete.

The collection of the samples must be done as soon as possible after apprehension. The suspect must not be fingerprinted nor allowed to wash prior to administering the GSR test.

It is essential that no contamination of the samples occurs during collection; samples should be taken by an officer who has received instruction in the use of the kit and who:

a) has NOT fired a firearm within at least 24 hours,

b) is NOT wearing clothing worn when recently firing a firearm,

c) takes the precaution to wash the hands and arms thoroughly before donning gloves from the kit provided.

Comparison Samples

The gun and ammunition involved (when available) must be submitted for test firing.

Significance of Results

The finding of characteristic particles containing all three elements, lead, antimony, and barium confirms the presence of GSR on the hands. This may be the result of activities such as firing a weapon, handling a recently fired weapon or cartridge, or having the hands in close proximity to a weapon during discharge.

Note: The following criteria will be used in accepting hand samples for the analysis of gunshot residue.

1. The samples must have been collected by a trained officer using the approved kit and technique. The questionnaire distributed with the kit must have been completed and returned.
2. The samples must have been collected within five hours of the time of the shooting incident.
3. The subject must not have washed his/her hands or subsequently been in contact with GSR (e.g. a police officer who has fired recently).
4. Since subjects known to have been in the vicinity of a shooting may have gunshot residue on their hands, whether or not they fired or handled a weapon, samples from victims of shootings will not be analyzed.
5. Samples that may have been accepted but subsequently are found to be heavily contaminated with blood or debris may not be analyzed.

GSR ON CLOTHING

In some cases it may be possible to analyze selected areas of an item of clothing for the presence of GSR particles. The officer should use the same precautions as have been outlined for the "Collection and Packaging of GSR on the Hands". In addition, to be considered for examination an item of clothing must meet all of the following criteria:

- it is known to have been worn by the suspected shooter at the time of the shooting.
- it was seized soon after the incident.
- it has a smooth fibre-free surface; for example, leather and nylon are acceptable; velour, suede and knitted garments are not.
- an area can be identified as having been near the gun at the time of discharge; for example, jacket cuff of the shooting hand can be examined; examination of the entire garment is not feasible.

Should questions arise about the suitability for analysis of clothing or non-clothing items, consult directly with the Chemistry staff.

Collection and Packaging

The clothing item should be packaged flat in a tightly fitting box. Folding of the garment should be avoided to minimize transfer of GSR away from the area of interest which should be covered with paper.

Comparison Samples

The gun and ammunition involved (when available) must be submitted for test firing.

Significance of Results

The finding of characteristic particles containing lead, antimony, and barium on the item of clothing confirms the presence of GSR. This may be the result of activities such as firing a weapon, being in close proximity to a weapon during discharge, or handling a recently fired weapon or cartridge.

SUSPECTED BULLET HOLES

Occasionally requests arise relating to the verification of holes or grazing marks as having been caused by a bullet. The holes may be in wood, plaster, clothing, tires or a wide variety of other materials.

Collection and Packaging

Cut out the hole including several centimetres of adjacent area to serve as a comparison sample. Package separately. If the hole cannot be removed, contact the Laboratory to discuss an appropriate sampling procedure.

Significance of Results

Detection of lead and other elements of a projectile's composition provides an indication that the hole or mark has been caused by a bullet.

COSMETICS

Collection and Packaging

1. Liquid or waxy substances should be placed in glass containers. Do not use plastic containers.
2. Where possible, the item with smears or stains should be submitted in its entirety, e.g. lipstick stains on a cigarette butt or on a piece of clothing. Package so that the smears will not contact the wrapping material.
3. Makeup should be removed from the face or from a non-absorbing surface using a soft white tissue or cotton swab. DO NOT use paper towels.

Comparison Samples

1. If an item of clothing cannot be submitted, cut out the smeared or stained area and an adjacent unstained area. Package separately.
2. Where containers of cosmetics are available for comparison, they should be tightly closed and packaged to avoid contaminating questioned samples.

Significance of Findings

Analysis may determine the type of cosmetic and may exclude or include the suspected source.

TEAR GAS AND NOXIOUS SUBSTANCES

Occasionally requests arise for the analysis of tear gas and other noxious substances (eg. acids, alkalis, bleach or other unknown chemicals).

If these are used in an assault then the contaminated articles must be seized, packaged and delivered to the laboratory with priority since the sample can be lost by evaporation or changed by chemical reaction.

Collection and Packaging

Note: Precautions should be taken to avoid contact with skin or eyes.

1. If the item is a commercially made product and the container is not damaged, a plastic bag is acceptable for packaging in most cases.

2. If the container is leaking, the item must be sealed in a glass jar. In most instances a mason jar is suitable; however, some safety precautions must be taken to avoid build up of pressure or reaction with the lid if the substance is suspected to be acidic.

3. If the substance has been thrown at a victim, the clothing items should be recovered; DO NOT DRY THE ITEMS AND DO NOT PACKAGE IN PAPER. Stained or contaminated areas of the clothing can be cut out to allow placing into a suitable glass jar.

   Liquids in pools or droplets can be absorbed onto swabs or tissue and placed in a suitable glass jar.

4. The apparent effect of the noxious substance on the victim and on the articles of clothing should be described on the Case Submission Form.

Significance Of Findings

1. For commercial products, the noxious ingredient and other relevant components (eg. the propellant) can be verified. Tests of the functionality of the device (eg. a spray can) are usually performed.

2. For stains or liquids, the material can usually be identified and its properties described.

OTHER TRACE MATERIALS

Materials occasionally encountered in investigations include vegetable oils and fat, adhesive tape, vaseline and other lubricants, gums and resins, soap and detergent, oil and grease, shoe polish, candle wax, tar and asphalt.

Collection and Packaging

1. Waxy or oily substances and liquids should be placed in glass containers (avoid plastic and paper boxes).
2. Fat or protein-containing samples should be collected in glass containers and kept refrigerated.
3. Solid and dried samples should be kept in clean boxes, bottles or bags.

Comparison Samples

Any materials submitted for comparison should be packaged and handled as are the questioned samples. They should be as large as practical (normally a few grams).

Significance of Findings

1. Identification of the type of substance.
2. Confirmation or suggestion of possible sources.
3. Identification of the unknown sample in terms of chemical composition or type of commercial product.

SOIL

Soil consists of loose aggregates of rocks, minerals and vegetation. Due to its widespread occurrence and its tendency to adhere to most materials, soil is frequently present on items of physical evidence. Common sources include cultivated fields, construction sites, banks of streams and rivers, paths, roadways and gardens.

Comparisons are made on the basis of colour, mineralogy and grain size. These three useful forensic properties serve to distinguish thousands of soil types. The evidential value of soil derives from the large number of distinguishable soil types and the limited area covered by each. The usefulness in any investigation will often depend upon the care taken by the investigator in collecting samples and upon the skill used in selecting the sampling locations.

Collection and Packaging

1. Examine clothing or other material for stains, smears or lumps of soil. The quantity of soil required for examination is quite small; an amount the size of a match head is sufficient in most cases. Because some soil may fall from clothing as it dries, collect the clothing as soon as possible. Do not remove soil from the clothing as this may result in the destruction of evidence.

2. Lumps or aggregates of soil with distinctive shapes or consisting of two or more layers are often found in car passenger compartments, at the scene of hit and run collisions etc. For example, a lump of mud found on a car floor may bear a cast of the ridges and grooves on the sole of a shoe or may bear a fabric impression. Do not use a vacuum cleaner to collect these samples. This will result in the mixing of different soils and in the loss of evidence. When practical, separate such lumps from other debris and submit as separate samples.

3. Examine the soil caked on the underside of a vehicle for places where chunks of soil are missing. Compare the shape of such gaps to the lumps of soil from the scene in an attempt to find a physical fit along one or more edges. If no physical match is found, collect samples from near each gap. Try to obtain whole chunks of soil by prying them loose with a flat blade wedged between the soil and the underside of the vehicle. When there are no obvious gaps, provide one sample from each fender and at least two other samples from the underside of the vehicle.

4. To prevent the growth of mould, dry clothing at room temperature before placing in containers. Package shoes, boots and other items which do not dry readily in strong paper bags, not plastic bags. The structure and shape of soil lumps should be preserved by first drying and then wrapping them in tissue paper before placing them in rigid containers.

Comparison Samples

1. To collect a soil sample, use any suitable tool to scrape about two tablespoons of soil from a surface area of about 15 cm x 15 cm into a plastic bag or vial. Wipe the tool clean between samples. Do not scrape below a depth of 1 cm

except in those cases where there are indications that the questioned sample may have come from a deeper layer of the soil. For example, when clothes are spattered by mud from a spinning wheel, provide control samples from the top, middle and bottom of the rut made by the tire.

2. When there is a footwear impression at the scene, provide a sample directly from it by scraping the surface and sides of the imprint after any photographs have been taken. If a cast is made from the impression, scrape soil from areas immediately adjacent to the impression avoiding locations contaminated by the cast material. Where there are several footwear impressions, provide a sample from each different soil in which there are imprints using colour as a guide to a change from one type of soil to another. Differences in soil colour can best be seen when the soils are dry.

3. Do not conclude from the absence of footwear impressions or other obvious marks that soil was not picked up. If the ground was wet at the time of the occurrence, it is likely that soil was picked up. In such circumstances sample the most likely places at and near the scene. Collect a comparison sample for each differently coloured soil at the scene.

4. Additional samples should be obtained from any location or locations where the suspect may have been, or claims to have been at the time the soil was deposited on the clothing or property.

5. Upon subsequent request by the CFS, provide eight delineating samples from around the scene at distances of 50 and 100 metres in four convenient directions at right angles to one another. It may be more convenient to collect these at the time of the initial investigation in those instances where the scene is remote or when it is expected that the ground will shortly be frozen or covered by snow.

6. Dry all soil samples by opening the containers to the air before packaging for submission.

7. Label the comparison soil samples with the exact location from which each was taken.

8. On the case submission form, describe the condition of the ground (wet, damp, dry or frozen) at the time of the occurrence.

Significance of Findings

There is a small possibility that indistinguishable soil samples may be found in two different places. Therefore, soil evidence is indicative rather than conclusive.

1. When questioned soil is similar to soil found at the scene and is different from soils taken from alternative locations as supplied by the suspect or investigator, it can be concluded that the questioned sample could have come from the scene. It can also be stated that the probability is low that a soil sample taken from a location 100 metres or more distant from the scene would be similar to the soil at the scene. When two or more soils from a suspect match soils found at the scene, the conclusion is that these soils probably came from the scene.
2. When questioned soil is similar to a soil sample taken from a location provided by a suspect or a complainant, it serves to corroborate the evidence of that person.
3. An examination of the location and type of soil found on the person or clothing of the parties in an assault case can be of assistance in corroborating testimony.
4. Industrial contamination of soil in urban areas by such materials as glass, paint chips, cinders and asphalt, often adds to the significance of the findings.

WIRES AND CABLES

Wires and cables that are certified by the Canadian Standards Association (CSA) have codings which assist in identifying their type (use) and manufacturer. Severed ends of wires and cables can be compared with other remaining ends and with tools that may have been used to sever them.

Collection and Packaging

1. Where a tool has been used to cut wire, metal or insulating covering, some of the material may adhere to the tool. Handle the tool carefully to prevent loss of evidence.
2. Protect the cutting edges of the tool from contamination.

3. When submitting wires for examination, remove 45 cm from all cut ends. Identify and protect the questioned ends.

Comparison Samples

Remove 45 cm of all cut ends remaining at the scene. Identify and protect the ends which are to be compared.

Significance of Findings

1. Wires and cables can sometimes be identified by means of their printed or indented coding or by a combination of coloured threads. The insulation on most cables is stamped with its identification every 30 cm or less.

2. When wire or similar material has been severed with a saw or file, a physical match of the two resulting ends is seldom possible because material has been removed as cuttings or filings. For the same reasons, it is normally not possible to identify the sawing tool.

3. If the tool performs a shearing or slicing action such as a knife, scissors, wire cutters or tin snips, it may be possible to determine that two corresponding ends were cut with the same tool.

METALS

Metal filings, cuttings etc. can be useful in associating a person or tool with a location or activity. The chemical analysis of a metal may be useful in confirming its identity or determining its possible usage.

Collection and Packaging

1. Collect and package metal particles in a small plastic box or bottle or fold in a sheet of paper and place in an envelope (Fig. l).

2. If the metal particles are adhering to a surface such as a tool, package to avoid loss or contamination (see WIRE AND CABLES) and submit the entire item.

Comparison Samples

1. A sample of metal from the suspected source of the particles should be submitted packaged as above.

2. If the type of metal is significant, supply any pertinent information as to its chemical specifications, usage etc.

Significance of Findings

1. In some cases, trace elemental analysis may be possible. This may confirm or eliminate the possibility that the samples could have a common origin.

2. The type of metal can be determined.

MECHANICAL FAILURES

Broken mechanical parts may be submitted for chemical, metallurgical or mechanical analysis. In accident investigations the broken parts should be photographed as found at the scene.

Collection and Packaging

1. If it is suspected that a defect in brakes, steering, accelerator linkage etc., led to or contributed to a collision, the vehicle should be examined initially by a qualified mechanic. If no defects are found or if only normal deterioration due to wear is found, no further examination is normally required. If, however, a defect is found, the cause of which is not apparent, such parts should be removed and submitted to the CFS for further examination.

   Fractured components should be kept dry to prevent rusting. Under moist or wet conditions, a fresh steel fracture may become covered with brown rust within one hour. If they cannot be maintained in a dry condition, fracture surfaces may be protected from rust by coating with clean motor oil or preferably petroleum jelly.

2. If chains, cables or ropes have broken, it is important to submit information about the configuration of the rigging involved including lengths, and approximate angles, block sizes etc. The weight of the load is also required.

3. Physical matches of broken chrome strips etc. should only be requested after consultation with an identification officer.

4. If tests for tensile strength are required, telephone consultation with the Chemistry Section of CFS prior to submission is necessary since these tests are not done on site.

Significance of Findings

1. Generally it can be determined whether a fracture is the result of an impact, overload or a pre-existing crack or defect.

2. It may be possible to relate two pieces of broken metal even though a physical match is not obvious.

3. In cases where there is structural failure or collapse, e.g. in hoisting operations, explosions etc., it may be possible to provide technical or engineering assistance in establishing the cause of such occurrences.

VEHICLE LIGHTS

Determination of whether lights were "on" or "off" at impact is usually possible when at least a portion of the filament is still present.

Headlights, tail lights, parking lights and directional signal lights near the area of impact damage can be examined and may yield useful information. The attitude of the bulb may be important i.e. vertical — base down or up, or horizontal — base forward or backward and this information should be noted on the Case Submission Form.

Collection and Packaging

1. Do not test the lights but observe the light switch to determine if it is "on" or "off".

2. Disconnect one of the leads from the battery.

3. Photograph the light before removing.

4. Disconnect from its wiring and carefully package the light.

5. Where the light is completely smashed, collect all debris from the headlight pot.

Significance of Findings

1. It is usually possible to determine if the lights were "on" or "off" when the lamp has been broken during the collision.

2. Even if the glass envelope is not broken, it may still be possible to determine the state of illumination at the time of impact.

RESTORATION OF SERIAL NUMBERS OR IDENTIFICATION STAMPS

1. If a torch is used to remove a piece of metal for serial number restoration be careful not to destroy the serial number by applying heat too near the area to be restored (keep at least 30 cm or more away if practical).

2. Serial numbers can sometimes be restored by the application of heat but where heat has been applied without success there is no chance of restoration by chemical etching.

3. Prior to submitting an item for restoration of serial numbers, ensure that a record of the suspected serial number is available. Where there is no record of the serial number of a stolen item, restoration serves no useful purpose.

4. Since in some instances the serial numbers are not completely and unequivocally restored, do not disclose the number suspected to the examiner until after the report is received.

   Note: Some police services have personnel trained to do serial number restoration, particularly on items such as automotive parts, bicycles and motorcycles. Items on which previous attempts have been made to restore serial numbers will not be accepted in the Laboratory.

TIRES

When a tire is to be examined for the cause of a failure, all the tires of the vehicle should be examined and their condition and location on the vehicle noted. The make, type, size and state of wear of the tires not submitted for examination should be included on the Case Submission Form.

Collection and Packaging

1. Submit the damaged tire still mounted on its rim. The condition of the rim is often of significance in assessing tire damage.

2. Severe vehicle instability may be caused by incipient tread separation of which there may be no visible external evidence. Where such a condition is suspected, all four tires should be submitted.

3. Identify the position of the tire on the vehicle.
4. If available, submit photographs of any skid marks and closeups of the damaged tire taken before the vehicle was towed or the wheel removed.
5. Submit a sketch of the scene, showing the point of collision, skid marks, final position of the vehicle(s) involved and the vehicle speed if known.
6. Submit information on vehicle(s) (make, model, year), road (type, number of lanes) and weather.

Significance of Findings

It can usually be determined whether the damage to a tire is the result of the collision or whether a puncture or other defect caused a sudden deflation.

Incompatibility of tire types and sizes can be hazardous and may contribute to vehicle instability.

SPEED DETERMINATIONS

Under certain conditions it is possible to determine the speed of vehicles from skid marks, trajectories or yaw-marks. It is generally not possible to provide a speed determination of useful accuracy from vehicle damage alone.

Information Required

1. Length of skid marks, etc.
2. Point of impact.
3. Final position of vehicle relative to point of impact.
4. Description of road surface, road condition and weather.
5. If the road has other than a normal grade, a road profile.
6. Where the speed change of a vehicle during impact must be evaluated, it may be necessary to know the speed of one of the vehicles just prior to the collision.
7. The weights (alternatively make and model) of the vehicles involved.

8. The weights of the occupants and any substantial cargo.
9. Whether two vehicles moved together or separately after impact.

The above information should be augmented by:

a) a sketch of the scene showing point of impact, skid mark locations, final place of rest of vehicle(s) and pertinent measurements,

b) a copy of the Motor Vehicle Collision Report and/or brief description of events,

c) if available, photographs of the scene and damaged vehicles,

d) if necessary, a surveyor's road elevation profile.

Two or three test skids should be conducted under similar road conditions at or as close as possible to the collision site and in the same direction of travel as the collision vehicle. It is not necessary to use the collision vehicle for these tests, nor is the weight of the test vehicle required.

If collision skid marks apparently resulted from fewer than all four wheels, the brake system of the collision vehicle should be checked by a qualified mechanic.

Occasionally vehicle trajectories, body trajectories or yaw-marks (long curving scuff marks left by a turning vehicle) are of use for speed determination or corroboration. Consult the Chemistry Section of CFS (416-314-3131) for details relating to measurements required in these circumstances.

In some cases, e.g. severe head-on collisions, speedometers can yield corroborating information.

VOICE IDENTIFICATION

The Centre of Forensic Science can assist investigators in the identification of speakers by voice analysis. **The results are provided as an investigative aid only, on the understanding that court testimony will not be provided.**

The results of voice comparisons generally depend on:

a) the length of both the known and questioned samples, or the number of comparison words and phrases common to the known and questioned samples,

b) the recording quality of both known and questioned samples,

c) the variability of an individual speaker's voice (intra-speaker variability).

Comparison Samples

1. To compare voices, it is necessary to have the same words, phrases and sentences in both known and questioned samples. Ideally, the known samples should contain the entire text of the questioned sample repeated at least 5 times.
2. Obtain voice recordings directly on a good quality tape and tape recorder.
3. Avoid extraneous voices and background noise whenever possible. Do not use a telephone to obtain a known sample.
4. Before recording the suspect's voice, test recorder and find the best position for the microphone in order to optimize recording quality. Make sure that the recording of the suspect's voice is done under these optimized conditions.
5. If the recording is done without the suspect's knowledge (hidden microphone and recorder) only prior testing can determine the optimal position of the equipment.

Collection and Packaging

1. Where a reel-to-reel recorder is available use polyester or nylon backed tape at least 0.025 mm thick. The recording speed should be 9.5 cm/sec or higher.
2. If a cassette recorder is used, only C-15 to C-60 cassettes should be used.
3. Submit original tapes except when the original is on multi-track tape. If a multi-track recorder is used to obtain a questioned sample, it must be copied directly (by use of a patch cord) onto a reel, cassette or DAT tape for submission.
4. Deliver tapes in person, or use a courier service. Do not ship by mail. For shipment, the tape should be suspended with packing material in the middle of a box 30 x 30 x 30 cm or larger.
5. Submit a typed transcript of all samples.

Significance of Findings

Upon completion of an examination, a written report will be sent to the investigator indicating one of the following opinions:

1. The voice samples probably have the same origin (one person).
2. The voice samples probably have different origins.
3. It is possible that the voice samples have the same origin.
4. It is possible that the voice samples have different origins.
5. The analysis is inconclusive: due to the insufficient number of comparison words, low quality recording, suspected disguise, unintelligible language, etc.

MAGNETIC RECORDINGS

Examination of magnetic recordings are provided for the following:

1. suspected tampering, editing, erasing, dubbing, etc.
2. relating a recording to a suspect recorder, eg. in cases of threatening messages.
3. enhancement of recordings to improve intelligibility by removing noise or amplifying the signal.

These examinations are normally done on audio tapes but in some cases, other media such as video cassettes and magnetic cards may be examined. Direct inquiries regarding these items to the Chemistry Section of CFS (416-314-3131).

Submit original tapes, microphones, tape recorders, transmitters, receivers and other equipment used directly or indirectly in the original recording.

ELECTRICAL AND ELECTRONIC EXAMINATIONS

Examinations of electrical and electronic devices for malfunction, misuse and/or criminal use are provided. This includes electrical installations, industrial machines, power tools, appliances, radio devices, medical devices, batteries, light bulbs, illegal electronic devices such as stun guns, lasers, police warning devices, etc.

Collection and Packaging

1. Before the device is removed, a detailed description should be made (with photographs) of the surroundings (shop, garage, basement, backyard, etc.), the conditions (wet, dry, dark, light, rainy, windy, stormy etc.), the device and its settings (positions of the switches, knobs and dials), the presence and condition of safety devices (fuses, circuit breakers, ground fault interrupters, isolation transformers etc.) and the condition of electrical cords, extension cords, plugs and receptacles. NO TESTING or OPERATION of the electric/electronic equipment or devices should be done prior to submission to the Centre of Forensic Sciences.

2. In cases of electrocution in a bathtub, swimming pool or other place where water is involved, measure and record the temperature of the water and submit a sample of the water (100 mL or more).

3. Whenever practical, package the entire device carefully; do not disturb any settings. If important, indicate the upright position on the package. If dismantling is necessary, this should be done only by a qualified person.

4. Deliver items in person or use a courier service.

GAMING MACHINES

Mechanical and video gaming machines are examined to determine whether or not they are games of chance and can be classified as gambling devices. In the case of 'bookmaking' and other types of illegal betting winning probabilities and percentage of returns are calculated.

Collection and Packaging

The original settings of the machines should not be disturbed; therefore, do not operate the machines nor examine the inside compartments. The door to the electronics compartment should be sealed with an evidence seal or tape. All keys and available documentation should be included with machines.

Significance of Findings

Examination will determine:

1. whether or not the machine is operational
2. whether or not it is a game of chance (skill factors)
3. the options provided by the game
4. the accounting system, hard and soft meters
5. whether or not the game is honest or gives unfair advantage to the operator.
6. the payback percentage
7. the presence of any "hidden" boards, programs and switches that may convert the gambling machine to an arcade-type machine.

DOCUMENTS EXAMINATION

CFS - PHONE(416) 314-3240
FAX (416) 314-3225

The services provided include the examination of:

1. Handwriting, handprinting and signatures.
2. Typescript, cheque protectors, rubber stamp impressions, price markers, labelling devices, photocopiers, fax machines and computer printers.
3. Erasures, indentations and alterations.
4. Pens, pencils, inks, paper, printing, bank notes, physical matching (e.g. cheques with cheque stubs), water damaged and charred documents.

HANDWRITING, HANDPRINTING, SIGNATURES

Collection and Packaging

1. Handle documents as little as possible during collection, investigation and transmittal. Place the documents in suitable envelopes.

2. Copies of documents are useless when microscopic or other physical examinations are required e.g. erasures, indentations, alterations or retouching in forged signatures. Whenever possible send original documents.

3. Unless prior fingerprint examination is imperative, send documents first to the Laboratory for examination. Fingerprint examination by immersion in or spraying with liquids often changes the colours of inks, destroying evidence of alteration. It may cause ink strokes to diffuse and smear, destroying evidence of forgery. The use of vapours makes differentiation of inks unreliable. Place these documents in plastic envelopes labelled "Preserve for Fingerprinting". This will ensure that they will not be handled.

4. Torn or fragile documents should not be repaired. Pick up carefully, place in a flat box such as a carbon paper box and deliver personally. Collect charred documents as described on p.102.

Comparison Samples

1. Comparison samples should consist of:

   a) "Collected" writings, i.e. writings collected from documents written in the normal course of business or social activity preferably near the date of the alleged offence.

      (i) Look for notebooks, address books, diaries, cheques, receipts, application forms etc.

      (ii) Collect as much as possible. Try to include writings similar to the questioned writings e.g. if the questioned writing is a cheque, the comparison samples should include cheques; if the questioned documents are in handprinting, the comparison samples must include handprinting.

b) "Requested" writings, i.e. those written at the request of the investigator.

  (i) Always dictate such samples; never hand the questioned document to a person to copy.

  (ii) Do not make any suggestions regarding spelling, punctuation or the use of capitals.

  (iii) Dictate the questioned material several times, having each sample written on a separate sheet of paper.

  (iv) If the questioned document is handprinted specify that the sample should be handprinted; if the questioned material is in lower case (small) handprinting the samples should be in lower case handprinting.

  (v) If the questioned document is on a printed form, obtain and use similar forms.

2. If cheques are in question, submit samples consisting of:

a) Collected writings, preferably on earlier cheques.

b) Ten requested writings containing the words and figures in question written on cheque blanks.

3. If anonymous letters or other documents are in question, submit samples consisting of:

a) Collected writings.

b) Requested writings containing the questioned material written five times to dictation.

4. Signatures - If a signature, e.g. "A.B. Smith" is in question, submit:

a) Genuine signatures of A.B. Smith — collected and requested, ten each, if possible; some of the collected signatures should have been written about the date of the questioned document.

b) Writings of the suspect containing the name "A.B. Smith" written to dictation ten times.

c) Other collected and requested writing of the suspect.

Significance of Findings

1. Positive findings can be made in most handwriting examinations provided sufficient questioned material and known samples are available.
2. It is usually possible to say whether or not a signature is a forgery but often not possible to say who forged it. Only if a signature is a poor copy i.e. reveals the suspect's own handwriting characteristics, can it be said that the suspect forged it.
3. If a signature is traced, no conclusion as to who traced it can be drawn.

TYPESCRIPT

Collection and Packaging

Submit the original document or documents in question, before fingerprinting.

Comparison Samples

1. The suspected typewriter should be submitted. Do not type on it after seizure.
2. If the typewriter cannot be submitted, remove and submit the ribbon for decipherment. Use another ribbon to type the following samples:
    - (i) The questioned material typed five times.
    - (ii) The whole keyboard, small and capital, three times (use double horizontal and vertical spacing).
3. Samples typed on the machine in the ordinary course of business.
4. The make, model and serial number of the suspected typewriter.

Significance of Findings

With sufficient questioned and known material, it may be possible to determine whether or not a document was typed on a particular typewriter or with a particular element (e.g. ball or daisy wheel). It is rarely possible to determine the make of the machine.

CHEQUE PROTECTORS/WRITERS

Collection and Packaging

Submit the original documents in question, before fingerprinting.

Comparison Samples

1. The suspected chequewriter should be submitted.
2. If this is not possible, submit:
    - (i) Samples made on it in the ordinary course of business.
    - (ii) Ten impressions of the figures in question in the order in which they appear on the questioned cheque.
    - (iii) Ten impressions of each of the symbols the machine can make i.e. ten rows of zeros to ten rows of 9's.
    - (iv) The make, model and serial number of the suspected chequewriter.

Significance of Findings

It is usually possible to determine that the impressions on a document were made on a particular make of chequewriter. Sometimes it is possible to identify a particular machine.

PHOTOCOPIERS

Collection and Packaging

Submit the photocopies in question, before fingerprinting.

Comparison Samples

(i) Ten samples of copies taken WITHOUT a sheet of paper in the machine.

(ii) Ten copies of a clean blank sheet of white paper. Submit the sheet and label the side that was face down (copied).

(iii) Submit samples that are contemporary with the questioned document.

(iv) The make, model and serial number of the suspected photocopier.

Significance of Findings

It may be possible to determine the specific machine used to make the copy. In problems of photocopy manipulation, it may be possible to determine the generation of a photocopy.

FAX MACHINES

Collection and Packaging

For suspected transmitting fax machines, submit the fax copies and any original documents which were the source of the fax copies. Do the same for suspected receiving fax machines and if the suspected receiving machine uses a thermal transfer ribbon for printing, submit available used ribbons from that machine. Collect any relevant fax confirmation reports or fax activity reports from the suspected transmitting machine.

Comparison Samples for Suspected Transmitting Machines

(i) Ten samples made by transmitting a clean white blank sheet of paper from the suspected fax machine to the receiving machine of the questioned fax copies, or a machine of the same make and model.

Submit the blank sheet, and label the side that was face down (imaged).

(ii) If possible, submit fax copies that are contemporaneous with the questioned fax copy.

(iii) The make, model and serial number of the suspected transmitting fax machine and the fax machine the questioned fax copies were received on.

Comparison Samples for Suspected Receiving Machines

(i) Ten samples made by transmitting a clean white blank sheet of paper from the original transmitting machine to the suspected receiving machine. If the make and model of the original transmitting machine is not known then use a transmitting fax machine which is capable of the degree of resolution found in the questioned fax copy. Submit the blank sheet, and label the side that was face down (transmitted).

(ii) Submit samples of fax copies that were received and printed by the suspected receiving fax machine and are contemporaneous with the questioned fax copy.

(iii) The make, model and serial number of the suspected receiving fax machine and the fax machine the questioned fax copy was transmitted from.

Significance of Findings

(i) It may be possible to determine whether or not a specific fax machine was used to transmit the questioned fax copy.

(ii) It may be possible to determine whether or not a specific fax machine received and printed the questioned fax copy.

COMPUTER PRINTERS

Collection and Packaging

Submit the original document/s in question before fingerprinting.

Caution: Do not generate/type the incriminating text using the suspect computer since it would not be possible to determine whether it was prepared by the suspect or by the investigator.

Comparison Samples

(i) Check the memory of the computer system and all hard drives and floppy disks for the questioned document. If found, use the hardware and software to generate approximately 10 pages (copies) of the document.

(ii) Submit the suspect printer/printers. Make note of applicable hardware/software e.g. (make, model, serial number).

(iii) If this is not possible, submit samples that are contemporary with the questioned document, made on the printer in the ordinary course of business.

(iv) Submit several blank sheets that have been run through the printer using the "Form Feed" button.

(v) Submit several samples of the printer generated using the "Printer Test" feature (if applicable).

(vi) If an impact printer is involved remove and submit the ribbon. Use another ribbon to make samples.

Significance of Findings

It may be possible to determine whether or not a document was produced using a specific computer printer.

RUBBER STAMPS, PRICE MARKERS AND LABELLING DEVICES

Collection and Packaging

Submit the original document on which the stamp, price or impressions appear before fingerprinting.

Comparison Samples

The stamp, price marker or labelling device and/or contemporary impressions made with these items in the normal course of business should be submitted.

Significance of Findings

It may be possible to determine whether a particular rubber stamp, price marker or labelling device was used on a document.

COUNTERFEIT DOCUMENTS

If examination is required as to whether a document such as a passport, birth certificate, seal, cheque or a driver's licence is genuine, attempt to obtain samples of the corresponding genuine document. Counterfeit bank notes should be submitted to the Counterfeit Bureau, R.C.M. Police, 1200 Vanier Parkway, Ottawa, Ontario, K1A 0R2. Phone (613) 993-0664.

Significance of Findings

It is generally possible to determine whether printed documents are genuine. It is also possible to establish what printing processes were used to print a document.

CHARRED DOCUMENTS

Collection and Packaging

Do not handle in any way but collect by:

1. Sliding sheets of paper under the charred document from both sides.
2. Lifting the charred material with the sheets of paper into a suitable box. The box should be deep enough for the char not to touch the lid. It should not be so large that the char moves around in it. It may be necessary to cut one side of the box so that the material may be slid into it.

Comparison Samples

When necessary, submit samples as described in previous pages.

Significance of Findings

Charred documents may be made legible and photographed. In some circumstances it may be possible to make comparisons with known materials.

INDENTATIONS, ERASURES AND ALTERATIONS

Collection and Packaging

1. If it is suspected these may be found on documents, handle carefully, lift into flat boxes or loose plastic folders sandwiched between cardboard to protect from further indentations.
2. Do not mark but attach a label specifying areas for examination.
3. Do not try to bring up indentations in any way.

Significance of Findings

Erasures, indentations and alterations may be deciphered and photographed.

MISCELLANEOUS EXAMINATIONS

Some of the other examinations conducted are:

1. Detection of invisible writing on documents.
2. Deciphering of faded or old writing.
3. Examination of offsets, postage stamps, safety paper, seals, watermarks, etc.
4. Examination of water damaged documents.
5. Determining whether unaccustomed hand was used in writing i.e. left hand by right handed person or vice versa.
6. Determining the sequence of intersecting strokes, lines, folds and indentations.
7. Differentiation and possible identification of writing instruments, i.e. pens, pencils and markers.
8. Physical and chemical examination of inks (pens), graphite (pencils) and papers.
9. Physical comparison of torn pieces of paper, cheques to particular stubs and sheets of paper to a particular pad.

FRAUDULENT CHEQUE FILE

The Centre of Forensic Sciences does not provide a Fraudulent Cheque File service. Submissions of this nature should be forwarded to:

Fraudulent Cheque File
Crime Index Section
R.C.M. Police
Ottawa, Ontario K1G 3M8
(613) 993-3800

NB: CONTINUE TO SEND CHEQUES FOR COMPARISON WITH COLLECTED OR REQUESTED WRITING OF A SUSPECT TO THE CENTRE.

FIREARMS AND TOOLMARKS EXAMINATION

CFS - PHONE(416) 314-3231
FAX (416) 314-3225

NRFL - PHONE(705) 945-6550
FAX (705) 945-6569

This field is primarily concerned with two types of examination, those relating to firearms and ammunition and those involving tools and marks made by them.

COLLECTION AND PACKAGING

Fired Ammunition

From a Body:

1. The pathologist should retrieve the bullets or bullet fragments by hand. **Forceps or other sharp or hard tools must not be used**. As many shotgun pellets as possible should be retrieved. Forceps may be used for these.
2. If the bullet is embedded in bone, the portion of bone containing the bullet should be removed.
3. Rinse blood off bullets, wadding and shot pellets and lightly pat dry. Ensure that any possible trace evidence present on a projectile is removed prior to rinsing.
4. **Do not mark the bullet.**
5. Put the bullet in a folded piece of paper (Fig. 1a), then place in an envelope, plastic box, bag or other suitable container. Each bullet should be packaged individually.
6. Shotshell wadding should be placed in a plastic box.

From the Scene:

1. If the bullet is embedded, cut out the area containing it. **Do not attempt to recover bullets with any type of tool**.
2. Do not attempt to clean the bullet.
3. Place each cartridge case in a separate container such as a plastic box or envelope. **Do not insert into a weapon or magazine**. Do not put initials or other identifying marks on any part of the case. Seal and mark container.

Unfired Ammunition

1. Package an unfired cartridge removed from the chamber of a firearm in a separate container from other unfired ammunition.
2. Do not remove unfired ammunition from detachable rifle or pistol magazines; submit the magazine. If cartridges have been removed, do not re-insert them in the magazine.

Firearms

1. Examinations for fingerprints, if necessary, should be done before submitting the firearm for examinations. When fingerprinting firearms, plug the muzzle with tissue paper and tape the open receiver areas in order to prevent chemicals from entering the action.
2. Remove any cartridges from a revolver. Note and number the position of the fired and unfired cartridges (clockwise in the loading position with #1 aligned with the barrel). If unable to remove all unfired cartridges from the weapon notify the Centre prior to submission. **Do not submit a loaded firearm without prior consultation**.
3. Remove the cartridge or case from the chamber and package separately.
4. Remove the magazine from a detachable magazine firearm.
5. Record make, model, type, calibre or gauge and serial number of the firearm on case Submission Form (CFS 69).
6. If no serial number or other unique mark is present, place initials on some inconspicuous area of the firearm or affix a CFS numbered seal to it.
7. If trace evidence e.g. blood, fibres, hairs, etc. may be present on the firearm, wrap with paper or plastic to prevent loss.
8. Do not operate any mechanism of the firearm, including adjustable chokes on shotguns, except to unload. Do not disassemble a firearm without prior consultation with the Firearms staff.
9. Do not clean firearms.
10. Do not test fire a firearm if it is to be submitted for examination.
11. Do not submit firearms for restoration of serial numbers if restoration has already been attempted.

12. Firearms found immersed in water should be kept in water and submitted to the Laboratory promptly. If necessary to remove from water, coat with lubricant and submit promptly.

13. Requests to determine if an unmodified commercially produced firearm is a "Firearm" and is capable of being fired are not normally accepted by the Laboratory. They can be test fired locally. Exceptions to this policy are made for air or gas operated firearms, antiques, modified and home made firearms where it is necessary to determine the velocity of the fired projectile and for correct identification/classification for registration purposes.

14. "Found" firearms that are not suspected of involvement in a crime are not normally accepted. Exceptions which may be accepted are "Found" firearms which have class characteristics in common with firearms involved in outstanding cases on file or which are found under suspicious or unusual circumstances.

15. Unquestioned suicide cases are not normally accepted for firearms examination. If an examination is necessary, all pertinent items must be submitted, as in a homicide investigation.

Firing Distance Determinations

Clothing

1. Avoid cutting or tearing through or near a suspected bullet hole when removing clothing from a body. Note the manner in which the clothing was worn i.e. back to front, inside out, etc.

2. Air dry blood-stained clothing at room temperature before packaging. Avoid unnecessary handling and any contact with an area suspected of containing discharge residues.

3. Protect the bullet entrance area by pinning or stapling paper or plastic over the affected area. Place cardboard behind this area to prevent excessive bending.

4. Place each item in a separate container of suitable size or wrap carefully in plain paper. Mark for identification. Clothing may be tagged in an area not blood stained or damaged.

Tissue

1. Cut beyond the blackened area (soot) surrounding the entrance wound and identify the 12 o'clock position with a suture (Fig. 9).
2. Place in suitable wide-mouthed container and add sufficient 10% formalin to cover the tissue (Fig. 10).
3. Where this is not practical, e.g. shotgun patterns, a colour photograph (with a scale) of the entire area should be submitted.

Other Material

1. If the firing distance may be a significant issue, submit the area around the hole (larger than the whole powder pattern).
2. Cover the affected area with paper or plastic sheeting and pack carefully.
3. Where the area cannot be submitted, photograph the area. Include a scale in the photo. Colour photographs are preferred.

Note: For analysis of gunshot residue on hands, see CHEMISTRY, p.73. For analysis of suspected bullet holes, see CHEMISTRY p.75.

Comparison Samples

1. All firearms involved.
2. All available unused ammunition (up to one full box) of the type involved from the scene, suspect's residence, etc.
3. Photographs of the scene.

Significance of Findings

1. Fired bullets may be identified as having been fired from a particular barrel, if the firearm can be test fired. If the bullet is fragmented or severely damaged a conclusive identification may not be possible. All fragments should be submitted in every case.
2. When no firearm has been recovered, it may be possible to determine the type(s) of firearm from which a bullet was discharged or in which a cartridge was fired.

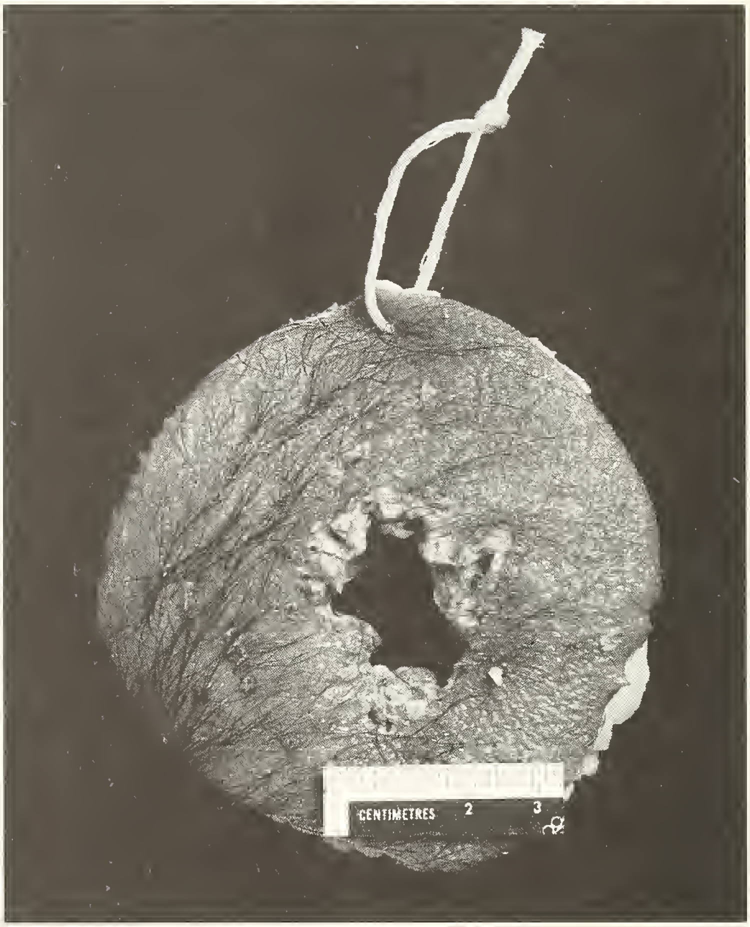


Fig 9 Excised tissue with bullet hole

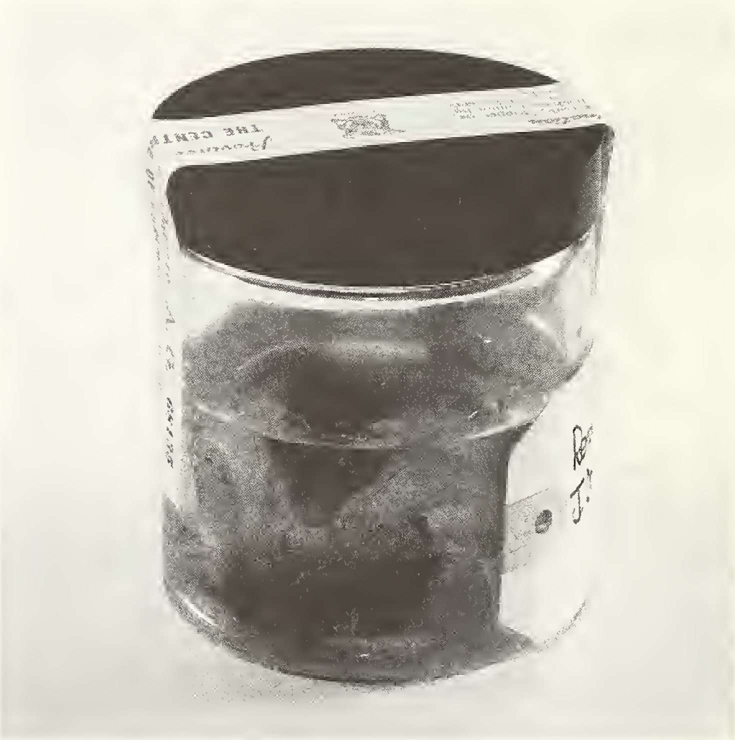


Fig 10 Tissue with bullet hole immersed in 10% formalin

3. Cartridge cases can be related to a specific firearm by marks placed on the case during the process of firing, loading or chambering.
4. Pellets and/or wadding may be related to a specific manufacturer or gauge of shotshell.
5. Firearm discharge residues surrounding a target surface (clothing, skin, etc.) may indicate the distance between the muzzle and the target surface. This can only be done if the suspect weapon and ammunition are available for test firing.
6. Two or more fired bullets or fired cartridge cases may indicate whether more than one firearm was used.
7. The mechanical condition and any tendency to accidental discharge of a firearm can be determined.
8. Muzzle velocities can be measured and other examinations made to establish if a firearm can be classified as a "firearm", a "restricted" or a "prohibited" weapon.
9. It may be possible to decipher obliterated or erased serial numbers on firearms.
10. From examination of bullet holes in glass, it may be possible to determine direction and sequence of shots fired.

TOOLMARKS

These include marks made by prying tools such as tire irons, screwdrivers and pry bars, cutting tools such as knives, axes and other sharp tools, and pinching tools such as pliers, cutters and crimping tools.

Collection and Packaging

1. Whenever possible, submit the object or the area containing the toolmark. Casts of toolmarks often do not reproduce the fine details. Consequently, any possible relationship between the toolmark and the suspect tool may be less than conclusive. If casting is the only means of retrieving the toolmarks, contact an identification officer or telephone the Firearm Section.

2. Place identification markings on the item in a location remote from the toolmarks.
3. Package in a rigid container or otherwise protect the area to prevent any alteration.
4. Ends of wires, cables, etc. should be tagged and protected by heavy paper or plastic and "suspect" ends clearly labelled.

Comparison Samples

1. All tools that may have been used should be submitted.

   Protect the working part(s) of the tool with heavy plastic or paper.

   Do not place a tool in contact with a questioned toolmark or try "cutting tools" to see if they are capable of cutting the item.

   Toolmarks produced by a saw are not normally accepted for comparison since the sawing action actually removes portions of the item being cut.

   Consider the possibility of contact traces (e.g. paint, metals) being present.

2. In cases involving door knobs or lock cylinders when vise grips or similar tools have been used, submit the opposite undamaged door knob or lock cylinder.

Significance of Findings

1. If sufficient individual characteristics are present, the toolmark can be related to a specific tool. This possibility is more likely if the mark is present on a hard smooth surface such as metal.
2. Indentations on softer surfaces such as wood may reveal only class characteristics and these may be common to a number of tools.
3. If no tool has been recovered, the general type of tool may be determined (e.g. blade dimensions, one or two cutting surfaces).

SLASHED TIRES

Collection and Packaging

1. Outline the damaged area using a suitably coloured grease pencil or similar marker.
2. Photograph the tire in place on the vehicle (include scale).
3. Remove the tire from the vehicle and rim.
4. Submit the entire tire.
5. Package to protect the damaged area.

Comparison Samples

All tools that may have been used should be submitted. Protect the cutting edge of the tool with heavy plastic or paper. Do not place a tool in contact with the cut. Do not try any suspect tool(s) to see if capable of cutting the tire(s). Consider the possibility of contact traces of rubber being present.

Significance of Findings

It may be possible to relate the damage to a specific tool.

PHOTOANALYSIS

CFS	**-**	**PHONE**	**(416) 314-3240**
		FAX	**(416) 314-3225**
NRFL	**-**	**PHONE**	**(705) 945-6550**
		FAX	**(705) 945-6569**

The camera or the microscope when used with a variety of light sources, filters, and films, can reveal information that is not otherwise apparent. Photographic examinations are useful in making physical comparisons of automobile pedals to footwear, paper matches, plastic bags, adhesive tapes, wires and cables, tin foil and also for detecting alterations and obliterations.

Photographic examinations are particularly useful in the following areas:

Physical Comparison

These involve establishing a relationship between two edges or surfaces that have been separated by tearing, cutting or breaking. Some characteristics common to two edges (Fig. 11) can be revealed either by enlargement or by specialized photographic techniques, e.g. the comparison of paper matches with a book of matches or the comparison of a gummed label with a surface.

Altered Machine Printing

Infrared and ultraviolet light sources have characteristics that are quite different from daylight. This difference can be exploited to reveal hidden information, e.g. the owner's obliterated name on a tape recorder or the erased serial number on material other than metal.

Miscellaneous Examinations:

1. Fraudulent items such as playing cards and dice;
2. Photographic items such as films or videotapes of robberies.

NOTE: If an examination or comparison can be made without a microscope or the specialized skill available at the Laboratory, an identification officer should be consulted (e.g. shoe prints or tire prints are not normally done at the Laboratory).

ADHESIVE TAPE

Collection and Packaging

Adhesive tapes are easily stretched and their edges altered. Therefore, submit them on the items to which they are attached. Should this not be possible, carefully mount them on a clean hard non-porous surface such as plastic.

Comparison Samples

Suspect tapes that are similar in colour, width and texture should be submitted.

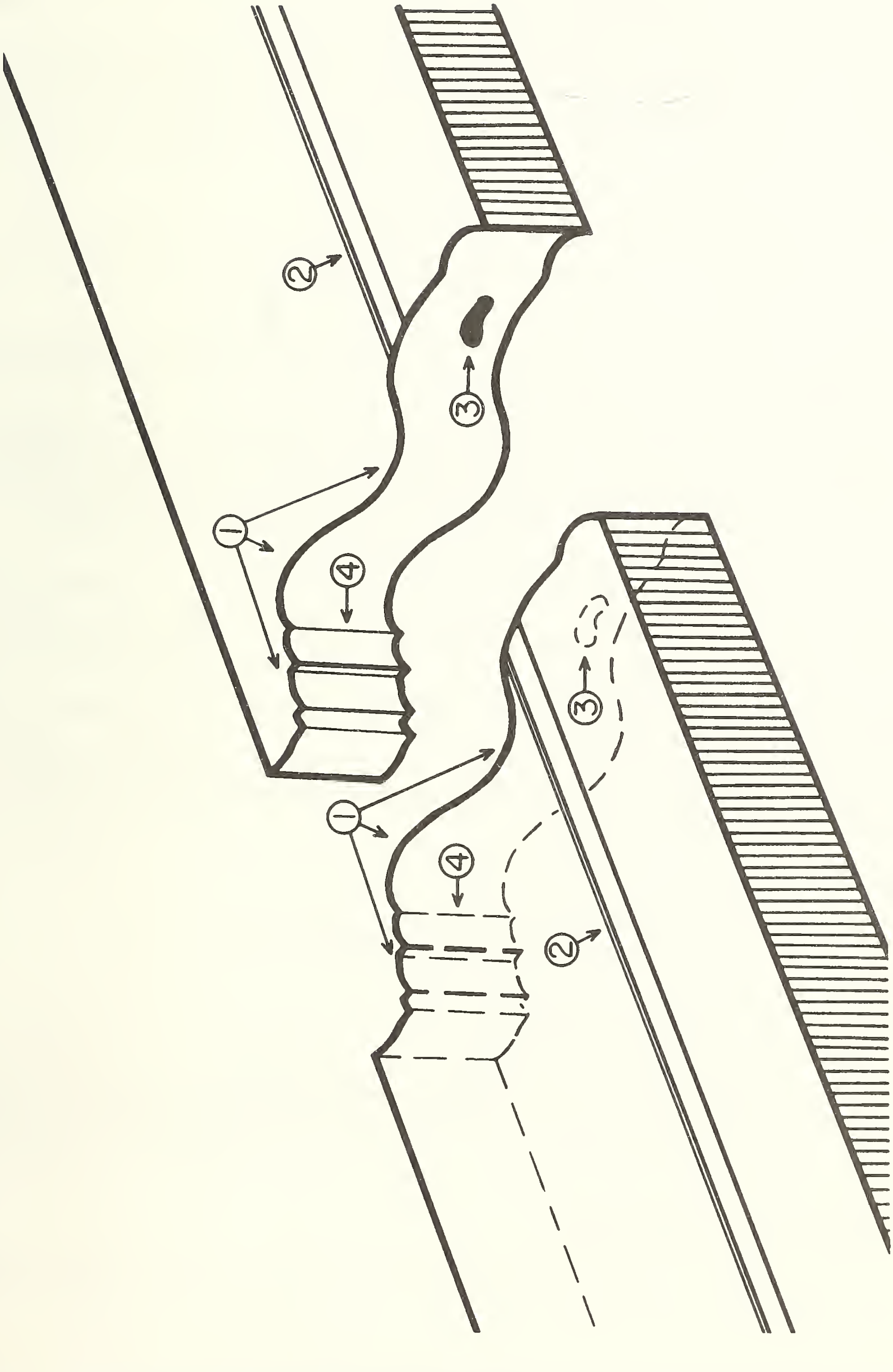


Fig. 11 Physical comparison. The numbered areas indicate where a physical match or comparison may occur

Significance of Findings

Tape ends that have been completely or partially cut or torn can frequently be matched. However, even if the end of a tape cannot be matched to another end it may still be possible to determine that they are related based on other features.

PAPER MATCHES

Collection and Packaging

As the comparison of paper matches is based in part on small inclusions or impurities along their cut and torn edges, they must be packaged to prevent further disturbance. Place in an envelope with cardboard as backing.

Comparison Samples

Used match books and matches in a suspect's possession should be submitted.

Significance of Findings

It is possible to determine whether or not a match came from a particular book of matches.

PLASTIC BAGS

Collection and Packaging

If it is necessary to remove the contents from a bag that has been closed with tape do not disturb the tape or the side of the bag. Cut a slit in the middle of the bag and remove the contents.

Comparison Samples

Submit all bags of similar size and colour in the retail package in which they were found.

Do not disturb the sequence of the bags remaining in the retail package in order to preserve the order in which they were manufactured.

Significance of Findings

It may be possible to determine whether bags from different sources originated from the same retail package or have a common origin.

PHYSICAL COMPARISON OF OTHER MATERIALS

Collection and Packaging

Fragments of metal, plastic, tin foil, etc. should be packaged individually to prevent any alteration to their edges. For wires and cables, see also CHEMISTRY, page 81. All surface patterns to be compared, (eg. deposits of oil, dust or glue) should be protected from contact with other surfaces.

Comparison Samples

All items that might be related to the questioned ones should be submitted.

Significance of Findings

Materials that have been separated by breaking, cutting or tearing can be related to each other based upon characteristics associated with the separated surfaces.

FOOTWEAR IMPRESSIONS

Requests for the comparison of footwear impressions should be made to an identification unit. An exception is when other examinations of the footwear involving the laboratory are required. In such cases the comparison(s) may be done by the Laboratory.

AUTOMOTIVE PEDALS

Collection and Packaging

Submit all pedals from each vehicle, e.g. brake pedal pad, parking brake, accelerator pedal, clutch pedal pad and rubber floor mats. It is advisable not to remove the accelerator pedal from its arm to avoid damaging the pedal, submit both parts together. Do not disturb the surface of the pedals during removal.

Comparison Samples

Both shoes from each suspected driver.

Significance of Findings

It may be possible to determine whether a particular shoe was in contact with a particular pedal. This may assist in identifying the driver and interpreting his/her actions at the moment of impact.

ALTERATIONS OF PRINT MEDIA, OR IDENTIFICATION MARKS ON VALUABLE ITEMS

Collection and Packaging

Package in accordance with basic requirements relating to continuity and preservation.

Comparison Samples

In the case of an erased serial number, supply a sample of each numeral: 0,1,2,3,4,5,6,7,8,9 by providing other labels or items of the same type. If necessary, photographs of these may be acceptable.

Significance of Findings

It is possible to reveal erased or obliterated printing of numbers, figures, etc.

ENHANCEMENT OF VIDEO TAPES AND PHOTOGRAPHIC MATERIALS

Collection and Packaging

Examination can be carried out on a full range of images including black and white photographs, colour slides, polaroid prints, motion picture films and video tapes.

Submit original tapes and photographs

Remove the original tabs on video cassettes.

Comparison Samples

When films from bank hold-ups are submitted, provide a photographic print of the suspect's face taken with similar illumination and from the same height and angle as the film.

Significance of Findings

It may be possible to identify persons in crime scenes, or provide additional information.

TOXICOLOGY

CFS - PHONE(416) 314-3143
FAX (416) 314-3225

NRFL - PHONE(705) 945-6550
FAX (705) 945-6509

Forensic toxicology is primarily concerned with the analysis for alcohol, drugs, and chemical poisons in human body specimens and with the interpretation of the resultant findings in relation to their possible effects on the body. Examinations are carried out on:

1. Body fluids and tissues.
2. Articles such as syringes, bottles, glasses, etc.
3. Tablets, capsules, powders, liquids and foods.

The types of cases examined include:

1. Deaths for which there is no clear cause.
2. Deaths in which at autopsy the cause is known but drugs may be a contributing factor.
3. Suspected poisonings.
4. Driving while impaired by alcohol or other drugs.
5. Fatal motor vehicle collisions.
6. Criminal cases in which the accused or the victim is suspected of being under the influence of alcohol or other drugs.
7. Drug cases in which charges have been laid other than or in addition to drug charges or in which the examination of body specimens as well as drug samples is required.

The Toxicology Section at the Centre of Forensic Sciences in Toronto also administers the Breath Testing Programme for the Province including training of police officers.

INFORMATION REQUIRED

The following information, when relevant, is required:

1. An outline of the circumstances.
2. The cause of death, if known.
3. Abnormal autopsy findings.
4. Medical history including drugs prescribed and **presence of an infectious disease**.
5. Any symptoms observed.
6. The time the bodily samples were collected and the site of collection.
7. The period of hospitalization, if applicable, and drugs administered.
8. Weight, age, sex.
9. Information on the presence or absence of decomposition.
10. The name of any drug or poison suspected. Any drugs or drug containers found at the scene.

GUIDELINES

1. In fatal motor vehicle collisions:
    a) Samples from passengers are not accepted for analysis unless circumstances indicate some active involvement of the passenger.
    b) Requests for carbon monoxide are not accepted unless circumstances indicate some possible significance to the investigation.
    c) Requests for analysis for drugs other than alcohol are not accepted unless investigative information is received that a specific drug or drugs may be implicated.
2. In other fatal accidents and suicides where the cause of death is well established and is not due to poisoning, requests for analyses for drugs other than alcohol are not accepted unless investigative information is received that a specific drug or drugs may be implicated.

3. In deaths clearly ascribed to natural causes, requests for analyses for drugs other than alcohol are not accepted unless investigative information is received that a specific drug or drugs may be implicated.

4. Cases of driving while impaired by drugs other than alcohol where only urine is available for analysis are not normally accepted. Where blood is submitted the case will be accepted. We encourage attempts to obtain blood **and** urine for analysis in these cases.

5. In cases of driving while impaired by alcohol, when breath test results are 100 milligrams per 100 millilitres or more and have been obtained within two hours of the occurrence, urine and/or blood samples are not normally accepted for alcohol analysis.

6. Requests for glucose analysis or other clinical tests (eg. electrolytes, insulin, hormones, etc.) available from hospitals are not accepted. These should be done locally.

7. Dry samples (stains) are not accepted for alcohol analysis.

8. Analyses of drug exhibits (plant material, powders, capsules, etc.) in investigations involving charges only under the Narcotic Control Act or the Food and Drug Act are performed by laboratories of the Health Protection Branch, Health and Welfare Canada, (see Appendix D). Consult this agency for their specimen and procedural requirements. These types of cases will be accepted by the Laboratory only when charges have been laid other than or in addition to the drug charges, or when the examination of bodily samples as well as drug samples is required.

9. Analyses of samples from animal poisonings are carried out at the Veterinary Services Laboratory, University of Guelph (see Appendix D). Consult this agency for specimen and procedural requirements.

10. When the suspected cause of poisoning is spoiled food, the necessary microbiological examination of the specimens can be performed at the Laboratory Services Branch of the Ontario Ministry of Health, Resources Road, Rexdale, Ont. Consult this agency for specimen and procedural requirements. Cases where the suspected cause of the poisoning is food to which chemical poisons or drugs have been added are accepted by the Centre of Forensic Sciences.

COLLECTION AND PACKAGING

Each bodily sample should be placed in a separate, leakproof glass or plastic container and each container sealed and labelled (Fig. 12). CFS will supply appropriate tubes for blood and urine collection. When those are not available, sterile Vacutainer(TM) tubes may be used. Tubes of choice are grey, red or green tops. CFS supplied tubes should be filled almost to the top with the specimen and the contents well mixed. Keep samples refrigerated until submission. Ship containers to the Laboratory by courier service, air or bus express or by the police. Label in capital letters "KEEP UPRIGHT".

Do not use:
- plastic bags for bodily samples.
- plastic containers for bodily or comparison samples when solvents such as chloroform, ether, glue, nail polish remover or gasoline are suspected. Use glass containers.

Fatalities

The following specimens are required for general toxicological examination:

Blood

1. One sample (10 mL) from femoral vein in a tube containing fluoride preservative/anti-coagulant mixture*, and
2. Three samples (30 mL) from an intact chamber of the heart in tubes containing fluoride preservative/anti-coagulant mixture*.

Note:

- When collecting blood, fill tubes (with the preservative mixture) almost to the top with the specimen, stopper the tube and rotate in order to mix the blood with the preservative mixture.
- Blood must be obtained whenever possible from a vessel (e.g. femoral vein) and/or an intact chamber of the heart. If not available, blood from the jugular or subclavian vein can be submitted.

---

* The preservative/anti-coagulant mixture contains sodium fluoride and sodium citrate in sufficient quantity to produce a final specimen concentration of 1% sodium fluoride and 0.5% sodium citrate. CAUTION: Fluoride is poisonous.

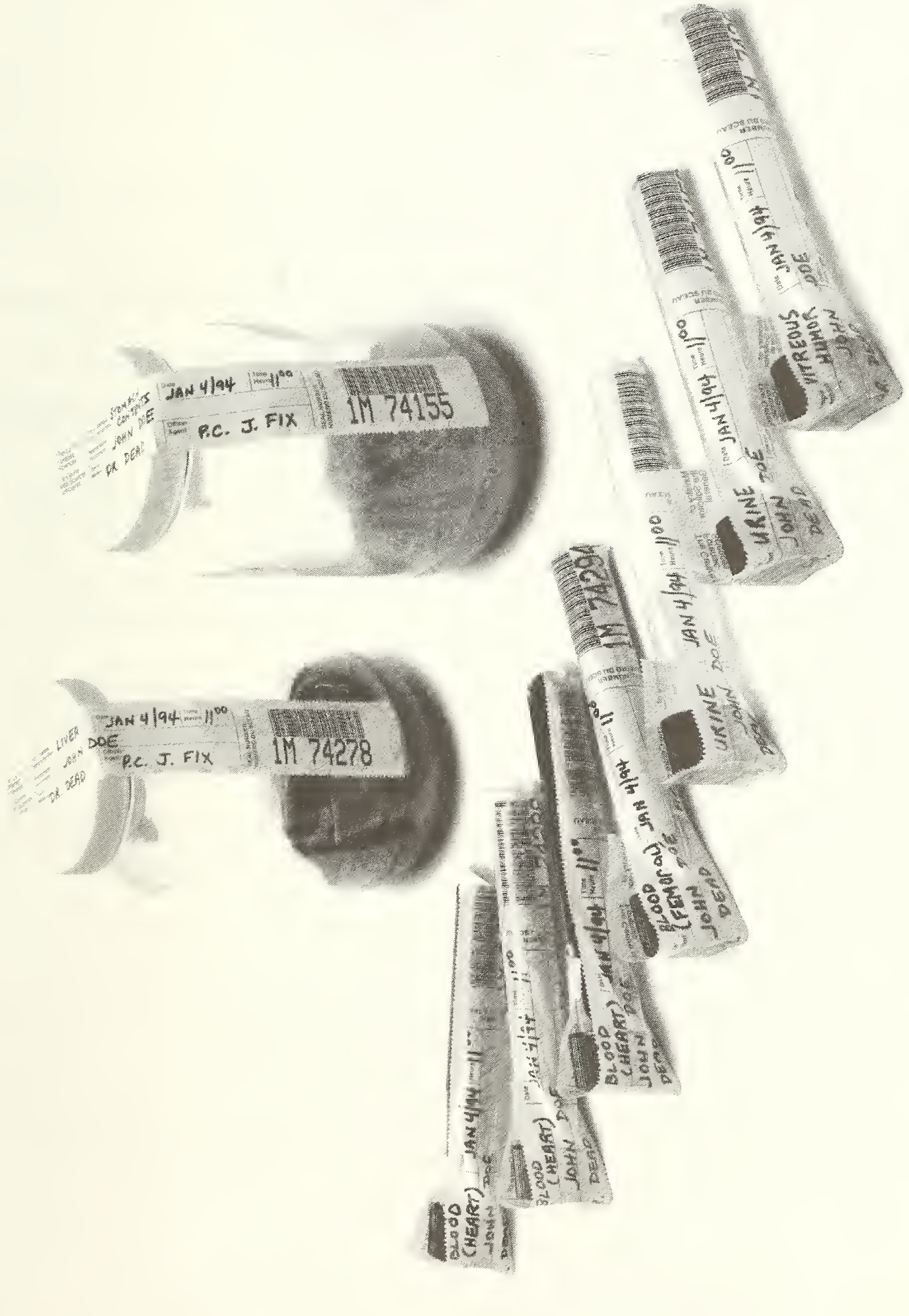


Fig. 12 Properly packaged specimens for toxicological analysis

- Blood from body cavities (e.g. chest) may be submitted when no other samples are available at autopsy. However, quantitative analysis or interpretation from such samples may not be possible.
- The source of the blood for each sample must be indicated on the Case Submission Form.
- Whenever applicable, submit available ante-mortem samples (blood/serum/plasma) obtained on admission to a hospital.
- Do not use fluoride preservative if fluoride poisoning is suspected.

Urine

Two samples (20 mL) in tubes containing fluoride preservative/anti-coagulant mixture.

Stomach Contents

Total contents in a jar — no preservative.

Liver

Approximately 60 grams in a jar — no preservative.

Special Requirements

In certain cases additional specimens are required. Contact the Toxicology staff if unusual circumstances or toxins are suspected. Examples:

Vitreous Humor

This sample is useful for alcohol analysis when there is evidence of decomposition or when blood and urine are not available. It is also useful for glucose analysis (not carried out at the forensic laboratories). Submit the contents of both eyes in one tube containing the fluoride preservative/anti-coagulant mixture. If only a small volume is available, discard some of the preservative mixture to prevent the formation of a sludgy matrix.

Lung

In cases involving flash-fire or explosion, or when an accelerant such as gasoline is suspected or when exposure to noxious or asphyxiant gases has occurred, submit a portion of lungs sufficient to fill an air-tight glass jar of about 1 litre capacity (Fig. 8, page 67). No preservative.

Bodies Without Blood

Carbon monoxide saturations can be determined in liver, lung, heart, spleen or, as a last resort in muscle. Submit approximately 60 g of tissue in a jar. No preservative.

Alcohol concentrations can be established in vitreous humor and urine. Drug screening can be performed on liver, lung and muscle. Concentrations of most drugs can be determined in liver tissue.

Living Persons

The following specimens are required for general toxicological examination:

Blood

If possible, submit 20 mL or more of whole blood, preferably in tubes containing the fluoride preservative/anti-coagulant mixture. Whole blood (oxalated, citrated, heparinized or with EDTA) or serum/plasma are also suitable for drug analysis. Do not use fluoride preservative if fluoride poisoning is suspected.

In impaired driving cases, approved container kits for blood alcohol are available from the CFS. These are also suitable for drug analysis.

Urine

Obtain a complete void. Transfer approximately 20 mL to tubes containing the fluoride preservative/anti-coagulant mixture.

Stomach washing (if applicable).

SIGNIFICANCE OF FINDINGS

The majority of common drugs or poisons can be detected in body specimens after the ingestion of toxic or lethal doses. Drugs or poisons detected and the concentrations, where appropriate, will be reported. Concentrations in the blood will be interpreted, whenever possible, as:

1. In the therapeutic range (blood concentrations expected to result from normally prescribed dosages),

2. Above the therapeutic range (toxic symptoms may occur), or
3. Above the minimum potentially fatal concentration (can cause death).

BREATH TESTING

Evidence that alcohol is (or is not) present can play an important role in many investigations. Analysis of breath to determine the blood alcohol concentration should not be limited to investigations of driving offenses. Breath tests have some important advantages over the collection of a blood sample for laboratory analysis. The main advantage is that the investigator knows within minutes whether alcohol is present and if so to what extent. With such knowledge it is possible to conduct a more thorough investigation at that time. Another advantage of breath analysis is that the suspect is interviewed by an officer trained to recognize the slight changes from normal which can be caused by low blood alcohol concentrations.

Equipment and Training

Courses are conducted by the CFS at various police locations to train police personnel in the use of breath testing equipment. The courses consist of a series of lectures and practical sessions. The lectures, in addition to covering the theory and operation of the equipment, include subjects such as systems of measurement, the strengths of alcoholic beverages, the absorption, distribution and elimination of alcohol from the body, the effects of alcohol on the body and the relationship between alcohol and traffic accidents. The practical sessions include a study of the components of the equipment, conducting tests on various substances to ascertain if they will give a reading, and conducting breath tests on subjects who have consumed known quantities of alcoholic beverages.

Those officers who successfully complete the course are certified by the CFS as “Operators”. They are also designated by the Solicitor General of Ontario as “Qualified Technicians” for the purposes of those sections of the Criminal Code of Canada which deal with drinking and driving. The continued competence of the technicians and the proper functioning of the instruments are assured by an annual evaluation and inspection by Field Co-ordinators.

Roadside Screening Devices

Although roadside screening devices are very simple to operate, it is recommended that some specialized training be given by the Police Services in their use. At least one person should be trained in the calibration and routine maintenance of the equipment and, whenever possible, this person should be a "Qualified Technician".

PATHOLOGY SERVICES

PHONE (416) 314-4040

FAX (416) 314-4060

Forensic Pathology Services are provided through the Office of the Chief Coroner in the Public Safety Division of the Ministry of the Solicitor General and Correctional Services. Enquiries should be directed to Forensic Pathology, 26 Grenville Street, Toronto - M7A 2G9 - (416) 314-4040.

Since in most medico-legal investigations there will be material associated with the body that may require examination at the Forensic Laboratory, the information given below is confined to such physical evidence.

General Procedures

In homicides and fatal hit and run cases or cases in which the cause of death is not clear, it is essential to preserve all evidence associated with the body. Some of this may be foreign material adhering to the body or clothing. Any noticeable material (e.g. loose hairs) which is likely to be dislodged in transport should be removed, properly packaged and labelled before the body is moved. Both hands should be covered with paper bags and the body placed in a clean plastic (non-fibrous) sheet or bag for removal to the morgue. This will prevent contamination from other sources (eg. fibres from a blanket) and preserve any loose material that may fall off. Soil or other contact traces present on the clothing may indicate a previous location of the body. Examination of injection sites and of punctures or stab wounds to determine the type of weapon or for relationship to a specific weapon is the responsibility of the pathologist performing the autopsy.

Duties of The Investigator at an Autopsy

1. Provide the pathologist with a history of the case.

   Discuss with the Pathologist and Coroner any additional information that may have been determined after the Coroner completed the Warrant for Post Mortem. Additional tests may be required and the Coroner may need to amend his/her warrant.

2. Photograph all pertinent evidence associated with the body, as directed by the pathologist. Always include a scale in the field being photographed.

3. Receive items from the pathologist, air dry clothing, package, label and submit to the Forensic Laboratory.

Collection and Packaging

Clothing (Also, see "COLLECTION AND PACKAGING", p.26)

1. Once the pathologist has examined the clothing in place on the body, it should be removed with the least possible disturbance. Do not cut or tear. If this cannot be avoided, cut so that the cuts will not interfere with subsequent examination. DO NOT cut through existing holes or tears or through any stains. Note any unusual manner in which the clothing was worn. Do not turn clothing inside out.
2. If wet, dry at room temperature as soon as possible.
3. Protect any areas of foreign deposits.
4. Place each item in a separate container.
5. Identify and tag with proper information.

Samples from Body

1. Hair for conventional identification/comparison. See under "BIOLOGY", p.44.
2. Hair for DNA. See under "BIOLOGY", p.41.
3. Vaginal Samples

   In cases of sexual attack on a female, swabs followed by an aqueous (approx. 5 mL) vaginal washing should be collected. Place each in a separate glass or plastic container and refrigerate. Do not add any fluid to swabs.
4. Mouth and Anal Swabs

   Swabs from the mouth and anus should be taken in appropriate cases. For oral/buccal swabs for DNA analysis, see under "BIOLOGY", p.41.
5. Saliva - For DNA analysis, see under "BIOLOGY", p.41.

NOTE: Air-dry all swabs thoroughly as soon as possible after collection.

6. Blood

- For DNA analysis, obtain 5-10 mL in a tube containing E.D.T.A. or in a tube without any anticoagulant/preservative. DO NOT USE TUBES CONTAINING FLUORIDE. In case of decomposed bodies, see under "BIOLOGY", p.44.

- For toxicological examination, blood should be drawn from a femoral vein and/or an intact chamber of the heart. If not available, submit blood from jugular or subclavian vein. Whenever possible, avoid taking blood from a body cavity. Collect in tubes with fluoride preservative/anti-coagulant mixture (see page 126), unless fluoride poisoning is suspected.

7. Urine

   Submit two 10 mL samples in tubes containing fluoride preservative/anti-coagulant mixture.

8. Vitreous Humor

   In appropriate cases, (see p. 128) submit the contents of both eyes in one tube containing fluoride preservative/anticoagulant mixture.

9. Organs

   For poisons or drugs, place a portion of each organ required (see p. 128-129) in a separate, leakproof, clean glass or plastic jar and refrigerate. In decomposed bodies where blood is not available, submit 50-100 gram portion of liver tissue.

10. Fingernail Samples

    In appropriate cases, cut all fingernails and place onto two separate clean sheets of paper, one for each hand. Fold papers and place in two envelopes (Fig. 1). Also, see "BIOLOGY", p. 46-47.

11. Ligature Marks

    Where a ligature is suspected but is not present, the area should be carefully examined by the pathologist and, if indicated, taped to pick up fibres (p. 33). Place the tape sticky side down on a transparent colourless plastic sheet, not on paper or cardboard. Also see "ROPES", p. 52.

12. Bullets or Pellets

    Place in an envelope or small plastic box (p.106). DO NOT handle bullets with metal forceps. Also see under "FIREARMS AND TOOLMARKS EXAMINATION", p.105.

13. Bullet Wounds

If examination for firearm discharge residues is required, the excised entrance wound should extend beyond all grossly visible blackening (soot), the 12 o'clock position identified with a suture, the tissue placed in a glass jar and covered with 10% formalin (p.109).

14. Stomach Contents

A representative sample should be placed into a leakproof glass or plastic container. The approximate volume should be estimated by the pathologist. Keep refrigerated.

Note: Estimating the state of digestion of food in stomach is the responsibility of the pathologist.

15. Maggots

Determination of the stage of the life cycle may assist in estimating the approximate date of death. For collection and packaging instructions, contact B. Blenkinsop or J. Arnold in the Forensic Pathology Unit, Office of the Chief Coroner.

16. Other Considerations

In unusual cases such as exhumations, special additional precautions may be required. If in doubt as to the type of sample required, consult the Forensic Laboratory or the Forensic Pathology Unit.

PART III

This section of the manual is intended as a ready reference to the common types of physical evidence available in certain types of investigations. The experienced investigator may not find this part as useful as one who is only occasionally involved in these types of investigations. Since the circumstances in each occurrence will dictate what can and cannot be done, this part should be **used only as a guide** and not as a check list. It is not all-inclusive and should supplement, not limit, the investigator's ingenuity and common sense. For details about the proper method for collecting, preserving and packaging the various types of materials mentioned, reference should be made to the appropriate section of Part II.

BREAK, ENTER AND THEFT

1. Make a detailed examination of the entry site and interior areas which the suspect may have contacted for traces of blood, fibres, hairs etc. Collect and preserve any such evidence.

2. Collect samples of all materials at the scene which a suspect might have contacted and which could have transferred to clothing or tools. Such materials include particles of glass, paint, wood, metal, grease, plaster, concrete and safe insulation. Be alert for any material peculiar to business premises such as metal turnings in a machine shop, printing ink, sawdust, flour, etc.

3. Collect any items at the scene such as clothing, paper matches, cigarette butts, tools, etc. which may have been left by the intruder.

4. Examine for toolmarks on locks, doors, windows, etc. Whenever possible collect the area bearing such marks. When this is not feasible, consult an identification officer. Submit tools only if they can be linked to a suspect.

5. Obtain the clothing of a suspect. Remove and package to avoid loss of loosely adhering materials such as glass, safe lining, etc.

6. If there is evidence of blood at the scene, collect and submit the item bearing the stain or swab from the stain. Attempt to obtain a sample of blood from the suspect. If unable to obtain blood, attempt to obtain a sample of pulled hair (with root sheaths) or an oral/buccal swab.

7. Wrap tools properly to prevent loss of any adhering material.

8. If a safe has been transported in a vehicle, check for transfer of paint between the vehicle and the safe.

9. Remove and protect ends of wires or cables that have been cut for comparison with a cutting tool. Identify the ends to be examined.

10. Paint examination is often useful even when an item has been repainted. Submit the entire item, or, if too large, a sample of the paint including all layers. If possible, include a comparison sample of the paint suspected to have been used.

11. Obliterated serial numbers can often be restored on metal, wood, plastic surfaces and on labels.

FATAL MOTOR VEHICLE COLLISIONS

1. Bodily specimens from the driver and/or pedestrian fatalities for alcohol and drug analysis should be collected under the authority of a coroner's warrant. For other information, refer to "Guidelines" on page124.
2. Tires or other significant parts of the vehicle may be examined to determine whether they failed or were damaged prior to or during the collision.
3. Vehicle lights may be examined to determine whether they were "on" or "off" at the time of the collision.
4. Footwear of the driver may be compared with control pedals and floor mats to establish the position of the feet at impact.
5. Skid marks and vehicle or body trajectories may be interpreted with respect to vehicle velocity or direction.
6. In a multiple vehicle collision, paint samples may be useful in establishing the sequence of events.
7. Where a question arises as to who was driving, the examination of hair, blood, etc. on the interior of the vehicle may be of assistance.

FIRES AND EXPLOSIONS

The examination of the site is particularly important in these investigations since much of the information as to possible cause is only available there. This type of examination is highly specialized and should be conducted only by persons experienced in this work. For fires and most explosions, assistance should be requested from the Fire Marshal's Office. For explosions resulting from homemade explosives, propellants, or high explosives, assistance should be requested from the closest police or military explosive disposal unit, Ontario Provincial Police Identification Unit or the Centre of Forensic Sciences.

Fires

1. Consider the possibility of another crime in addition to arson, e.g. break and enter.
2. Search for unusual odours which may suggest the use of a flammable liquid. If detected, attempt to localize them and collect samples of the debris from that area in airtight glass containers. It is frequently necessary to clear away surface debris during this search.

3. With the aid of a witness familiar with the site, search for any containers foreign to the site. Collect them and stopper if open.

4. If an area of origin is established, examine minutely for remains of possible ignition materials (melted containers, timing devices, candle wax etc.).

Explosions

1. Exercise care in moving about the site because of the possibility of unexploded material remaining.

2. If gas or vapour is suspected, collect an air sample as soon as possible. Look for areas where gas or vapours may have accumulated.

3. Photograph the site and submit copies of the photographs along with the items for examination.

4. Search carefully for the remains of fuses, wires, batteries, containers and possible timing or triggering mechanisms.

5. Collect samples of the debris from the suspected seat of the explosion. Metal, wood, glass, concrete, soil, insulation, carpet, drapery and/or other cloth from near the seat of the explosion are the best materials for examination.

6. **CAUTION — DO NOT** send explosive materials to the Laboratory by common carrier. Consult by telephone before delivering.

FIRE DEATHS

In cases of fire deaths, toxicological analyses are normally carried out for carbon monoxide and alcohol, although, in some cases, analysis for cyanide may also be indicated. Under certain circumstances, the absence of carbon monoxide may indicate that the victim was already dead when the fire started and an extensive toxicological examination may then be necessary. This must however, be carefully interpreted and related to the type of fire.

The specimens required for carbon monoxide and alcohol tests are blood and urine. If the presence of other drugs is suspected, additional specimens should be submitted. However, in all cases it is advisable to collect all the required body specimens including lungs and fluids at the time of autopsy and retain them until the investigation has been completed.

If blood is not available, such as in badly burned bodies, carbon monoxide can be determined in organs such as liver, lung, heart, spleen or, as a last resort in muscle. Alcohol can be determined in vitreous humor (eye fluid) and in urine.

Clothing from the deceased and lung tissue should be collected if the use of accelerants or leaking gas is suspected.

HIT AND RUN

1. Collect all clothing worn by the victim. Handle and package to avoid loss or contamination.

2. If no suspect vehicle is known, submit the clothing immediately to the Laboratory. Examination of any paint present on the clothing may indicate colour and possibly make and model of the vehicle. Grease or oil on the clothing may indicate contact with the underside of the vehicle.

3. Collect all pertinent evidence at the scene such as items carried by the victim and material left by the vehicle such as paint, glass, soil, etc. Handle these items with care, since often they can be physically matched to the vehicle involved. It may be possible to determine the type of vehicle involved by parts left at the scene. This should be done by the investigator.

4. Obtain comparison samples of hair and blood from the body. Ascertain the nature and location of injuries. If, for example, the thigh area is lacerated, obtain hairs from this area.

5. A suspect vehicle should be examined in a protected well lit area. This examination should include a detailed search for trace evidence on areas that may have been in contact with the victim or object. If it is possible that the victim has been run over, a careful examination should also be made of the underside of the vehicle to determine the presence of hairs, fibres, blood, etc.

6. Whenever possible submit the parts of the vehicle bearing evidence such as fibres, blood, brush marks, fabric imprints, etc.

7. If hairs, tissue or foreign paint have been found on a vehicle, photograph the areas (include a scale) before the items are removed. The same applies to a fabric imprint on a vehicle that will not be brought to the Laboratory. The negatives and prints should be submitted. Photos of tire marks and road conditions may also be helpful.

8. Obtain comparison samples of paint from all damaged areas of the vehicle. Paint samples should include all layers down to the metal surface.

9. Collect parts with fractured edges, parts where metal is missing and the remains of broken glass. Physical matches of broken metal, e.g. chrome strips, should only be submitted after a consultation with an identification officer.

10. If a bicycle or tricycle is involved, submit the entire unit.

11. If a vehicle is to be examined at the Forensic Laboratory, contact the Laboratory's Receiving Office or "On Call" staff in advance.

HOMICIDES AND OBSCURE DEATHS

1. Photograph all pertinent areas and objects at the scene. Some photos should show the arrangement of the clothing, others the location of the injuries on a body. A closeup colour photograph of bullet wounds, including a scale, is desirable. Occasionally powder residues can be seen in tissue around a bullet entrance hole. They should be photographed before the blood dries and becomes dark. Ropes with knots should be photographed before removal. It is useful to photograph significant objects like furniture or a weapon that is near a body. The distribution of blood and/or other body fluids on these objects or on the floor and walls should be photographed. Refer to "Bloodstain Pattern Interpretation", p.35. The location and shape of any stain should be photographed before it is removed from an object. The same applies to any stain that cannot be brought to the Laboratory. If a shotgun was used, a photograph of the pellet holes may be helpful in determining distance. A scale must be included in these photographs. Should significant events in a homicide be distributed over several rooms, photographs should show the relationship between these rooms.

2. All items requiring fingerprinting should be treated before submission to the Laboratory **except** documents and bloodstained items. Special care should be taken to alert the examiner to the need for fingerprinting of the item in question. Before fingerprinting, remove and package any loosely adhering hairs, fibres or other trace evidence.

3. Whenever possible, submit weapons such as firearms and knives or anything used as a weapon such as clubs, boots, motor vehicles, etc. for detailed examination.

4. Remove and collect clothing carefully to preserve trace evidence. In most instances, clothing should be dried before packaging. Exceptions include clothing for flammable materials or noxious substance examinations.
5. Collect and preserve all foreign material and/or stains adhering to the body.
6. Obtain appropriate samples of bodily specimens of blood, hair, urine, stomach contents, etc. See under "BIOLOGY" and "TOXICOLOGY", pages 23 and 123.
7. If the possibility of sexual assault cannot be eliminated, obtain samples from the appropriate body orifices.
8. In cases where identification of human remains is in question, consider all possible characteristics associated with the body that may bear on identity (fingerprints, footprints of infants, teeth, tattoos, birthmarks, amputations, scars, deformities, bone disorders, etc.)
9. Obtain all pertinent clothing from a suspect.
10. Whenever possible, obtain samples from the suspect for possible comparison with samples found elsewhere (scalp and pubic hair, blood, oral/buccal swabs, etc.)
11. Collect any other comparison material that is related to the suspect and which may be compared with similar material associated with the crime.
12. If "alibi" locations are given, obtain appropriate samples from such locations.
13. Examine any vehicle used in the crime for evidence that may be related to the deceased, the scene or the accused.

IMPAIRED DRIVING

Alcohol

Breath

Analysis of breath for alcohol should be done whenever possible and as soon as practicable, consistent with statutory requirements.

Blood

Blood samples should be collected by a qualified person if breath analysis is not available. Approved container kits for blood alcohol are available from the CFS and should be used whenever possible. In their absence, blood can be collected in tubes containing the fluoride preservative/anti-coagulant mixture. Also, see "TOXICOLOGY", page 123. Alcohol or alcohol containing agents must not be used to sterilize the skin.

Urine

Urine alcohol analysis can be of value when there has been a significant time interval between the occurrence and the collection of the samples.

When blood or breath samples are not available, two urine specimens should be collected with an interval of approximately one-half hour between. Care should be taken to record the times that the samples were obtained and that the subject completely emptied the bladder for the first sample.

Place urine samples in tubes containing the fluoride preservative/anti-coagulant mixture.

Drugs

Blood

As described under "Alcohol" page 143.

Urine

Obtain urine in addition to blood. Collect a complete voiding and transfer 20-30 mL into tubes containing the fluoride preservative/anti-coagulant mixture. Note: urine is a supplement and not an alternative to blood for these purposes. If only urine is submitted, the case will not normally be accepted.

SEXUAL ASSAULTS

1. Have the complainant examined by medical personnel at the earliest opportunity. There is a progressive loss of evidence related to semen from body orifices with time.
2. The Sexual Assault Evidence Kit (SAEK) should be used by medical personnel for the collection and recording of specimens and items from the

complainant. The complainant (or guardian where applicable) must sign the Consent Form agreeing to the collection of specimens.

Note:Containers for the collection of specimens and/or items from the accused or from third parties, e.g. boyfriend/husband, etc., should be supplied by the police and/or hospitals as applicable.

3. SAE Kits are supplied to all police forces in Ontario by the CFS.
4. Responsibilities of the Doctor and/or Nurse
    a) Before proceeding with the examination and collection of specimens for forensic analyses, ensure that the complainant or guardian has read and understands the meaning of the Consent Form and has signed the form authorizing the collection of specimens. If the complainant or guardian will not sign the Consent Form then the SAEK should not be used.
    b) Where consent is obtained, the doctor and/or nurse should obtain the necessary information to complete the Sexual Assault History Form contained in the kit.
    c) Collect, package, record and complete labels for identification as detailed on the instruction form of the kit.
    d) The items collected should be recorded on the SAEK Forensic Evidence Form and the doctor/nurse should check the items off with the police officer at the time they are given to the officer. The form should then be signed by the doctor/nurse and by the officer and dated. The original copy of the form is retained by the doctor/nurse and two copies are given to the officer receiving the items. One copy is retained by the police and one copy is for submission to the Laboratory along with the items.
5. Responsibilities of the Police Officer
    a) Ensure that the items received from the doctor/nurse are in accordance with the listing on the Forensic Evidence Form.
    b) Ensure that the items are dried and packaged properly and labelled prior to submission to the Laboratory.
    c) Select for submission to the Laboratory only those items which are considered of potential value in providing answers to questions at issue and retain the balance of the items. **Items being submitted are to be listed individually on the Case Submission Form (CFS 069).**

In "No Suspect" cases submit only:

i) blood, urine and saliva samples from complainant,

ii) vaginal, anal, oral specimens as applicable.

When a suspect is apprehended, then additional submissions may be made.

6. Items other than those from the complainant e.g. suspect, scene, third person, etc.:

   a) Obtain blood, oral/buccal swabs, saliva, scalp and pubic hair samples from the suspect.

   b) If a third party has had intercourse (without the use of a condom) with the complainant within 7 days prior to the assault, obtain a blood sample or other suitable comparison sample from that person. Do not use the containers in the SAEK for the collection of these specimens.

   c) Obtain clothing which may contain evidence relating to the offence from the suspect.

   d) Collect bedding, car seats, covers, soil, vegetation, etc. from the scene.

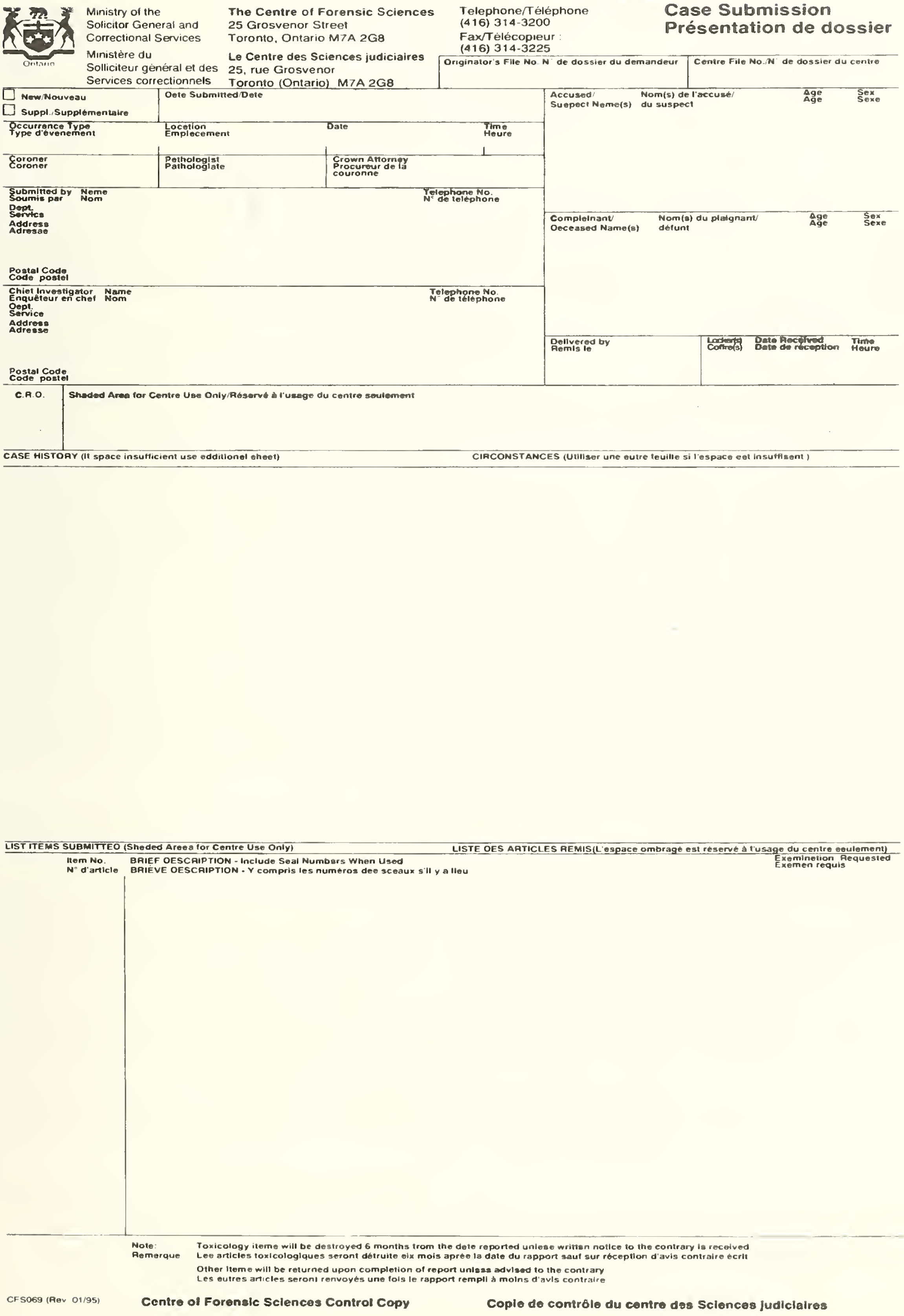
   CAUTION: When handling and packaging items of clothing from the suspect and complainant and/or items from the scene, guard against cross-transfer of trace evidence (hair, fibres, debris, etc.) by handling items from each source separately.

   Use a clean surface when packaging.

7. In preparing the Case Submission Form list all items being submitted and include a case history outlining the details of the occurrence. It is not sufficient to simply include the forms contained in the SAEK.

APPENDIX A

CASE SUBMISSION FORM (CFS 069)



Ministry of the
Solicitor General and
Correctional Services
Ministère du
Solliciteur général et des
Services correctionnels

Ontario

The Centre of Forensic Sciences
25 Grosvenor Street
Toronto, Ontario M7A 2G8

Le Centre des Sciences judiciaires
25, rue Grosvenor
Toronto (Ontario) M7A 2G8

Telephone/Téléphone
(416) 314-3200
Fax/Télécopieur :
(416) 314-3225

Case Submission
Présentation de dossier

Originator's File No. N° de dossier du demandeur	Centre File No./N° de dossier du centre

☐ New/Nouveau
☐ Suppl./Supplémentaire

Date Submitted/Date

Occurrence Type Type d'événement	Location Emplacement	Date	Time Heure
Coroner Coroner	Pathologist Pathologiste	Crown Attorney Procureur de la couronne	

Submitted by / Soumis par — Name / Nom — Telephone No. / N° de téléphone
Dept. / Service
Address / Adresse
Postal Code / Code postal

Chief Investigator / Enquêteur en chef — Name / Nom — Telephone No. / N° de téléphone
Dept. / Service
Address / Adresse
Postal Code / Code postal

Accused/ Suspect Name(s)	Nom(s) de l'accusé/ du suspect	Age Age	Sex Sexe
Complainant/ Deceased Name(s)	Nom(s) du plaignant/ défunt	Age Age	Sex Sexe

Delivered by Remis le	Locker(s) Coffre(s)	Date Received Date de réception	Time Heure

C.R.O. — Shaded Area for Centre Use Only/Réservé à l'usage du centre seulement

CASE HISTORY (If space insufficient use additional sheet) — CIRCONSTANCES (Utiliser une autre feuille si l'espace est insuffisant)

LIST ITEMS SUBMITTED (Shaded Areas for Centre Use Only) — LISTE DES ARTICLES REMIS (L'espace ombragé est réservé à l'usage du centre seulement)

Item No. N° d'article	BRIEF DESCRIPTION - Include Seal Numbers When Used BRIÈVE DESCRIPTION - Y compris les numéros des sceaux s'il y a lieu	Examination Requested Examen requis

Note: Toxicology items will be destroyed 6 months from the date reported unless written notice to the contrary is received
Remarque: Les articles toxicologiques seront détruits six mois après la date du rapport sauf sur réception d'avis contraire écrit

Other Items will be returned upon completion of report unless advised to the contrary
Les autres articles seront renvoyés une fois le rapport rempli à moins d'avis contraire

CFS069 (Rev 01/95) **Centre of Forensic Sciences Control Copy** **Copie de contrôle du centre des Sciences judiciaires**

APPENDIX B
GUNSHOT RESIDUE KIT INSTRUCTIONS

CENTRE OF FORENSIC SCIENCES
GUNSHOT RESIDUE KIT INSTRUCTIONS
FOR USE BY TRAINED PERSONNEL ONLY

IMPORTANT
DO NOT CONTAMINATE THE SAMPLE
WEAR the gloves supplied and avoid touching the aluminum stub,
the exposed adhesive and vial mouth. IF CONTAMINATION IS SUSPECTED,
DISCARD THE STUB.
THIS KIT IS FOR USE ON THE BACK AND THE WEB OF THE HAND ONLY

Each GSR kit consists of two plastic boxes, one for the right hand of the subject and one for the left hand. Four samples should be collected: Right Web, Right Back, Left Web, and Left Back.

SAMPLING PROCEDURE

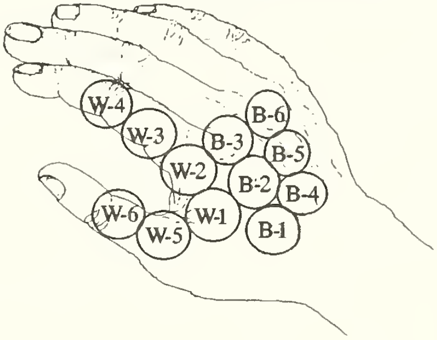
1. Place a large sheet of clean paper on the surface to be used for the test.

2. Open one of the plastic boxes and PUT ON DISPOSABLE GLOVES BEFORE HANDLING VIALS.

3. Remove the rubber stopper from the sample vial. Repeatedly and gently press and lift the adhesive stub on the hand being sampled until the stickiness of the stub is no longer felt, following the pattern shown in the diagram on the right. DO NOT twist, roll or slide the stub on the sampled surface.

Dab the "web" stub in the areas marked W-1 to W-6.

Dab the "back" stub in the areas marked B-1 to B-6.



4. Using one stub for the web area of the right hand, sample the areas shown in the diagram as W1 to W6.

5. Insert the rubber stopper, with the adhesive stub, back into its original vial. Indicate the hand from which the sample was taken, and the area of the hand, in the space provided on the label, ie. RW for right web.

6. Using the other stub for the back of the right hand, sample the areas shown in the diagram as B1 to B6.

   Cover the stub and label as above, ie. RB for right back.

7. Seal the box of vials, using the CFS seal supplied. Mark for identification, indicating which hand was sampled.

8. Follow steps 3-7 using the other box of vials to sample the subject's left hand.

9. Fill in the questionnaire, and forward the kit, the completed questionnaire and a submission form to the Centre of Forensic Sciences. Also forward the gun and ammunition used, if available.

GSR KITS WILL NOT BE ANALYZED UNLESS A COMPLETED QUESTIONNAIRE IS SUBMITTED WITH EACH KIT.

ATTACH QUESTIONNAIRE TO CASE SUBMISSION.

GSR Particle Handsampling

January 1994

Français au verso

APPENDIX B (CONT'D)

GSR QUESTIONNAIRE

CENTRE OF FORENSIC SCIENCES

GSR QUESTIONNAIRE

PART I To be completed at time of sampling

GSR kit # ______________

Sample taken by (Rank, Name, Badge No.) ______________________________

Subject whose hands were sampled (Name) ______________________________

Subject is ☐ Living ☐ Dead

Condition of hands ☐ Clean ☐ Dirty ☐ Sweaty
☐ Bloody ☐ Other ______________________

Date and time of sampling ______________________________

PART II To be completed by the investigator, if this information is known

Type of case ______________________________

Date and time of incident ______________________________

Did the shooting occur indoors or outdoors? ______________________________

No. of shots fired ______________________________

Firearm type ______________________________

Ammunition - Type and manufacturer ______________________________

NOTE: Samples will not be accepted for analysis if subsequent to the incident the subject washed his/her hands or was in contact with GSR.

APPENDIX C

REGIONS OF ONTARIO SERVED BY THE NORTHERN REGIONAL FORENSIC LABORATORY

The area served by the Northern Regional Laboratory consists of the districts of Sudbury, Algoma, Thunder Bay, Rainy River and Kenora. The Municipal Police Forces in this area are: Atikokan Township, Dryden, Elliot Lake, Espanola, Kenora, Marathon, Michipicoten Township, Red Rock Township, Sault Ste. Marie, Sudbury, Terrace Bay Township and Thunder Bay.

OPP Detachments served: Armstrong, Atikokan, Beardmore, Blind River, Chapleau, Dowling, Dryden, Ear Falls, Elliot Lake, Emo, Espanola, Foleyet, Fort Francis, Geraldton, Gogama, Gore Bay, Grassy Narrows, Hornepayne, Ignace, Kakabeka Falls, Kenora, Killarney, Little Current, Longlac, Manitouwadge, Manitowaning, Marathon, Minaki, Mindemoya, Nakina, Nipigon, Noelville, Pickle Lake, Rainy River, Red Lake, Sault Ste. Marie, Schreiber, Shabaqua, Sioux Lookout, Sioux Narrows, Spanish, Sudbury, Thessalon, Thunder Bay, Vermilion Bay, Warren, Wawa and White River.

First Nations Police Offices served are: Bearskin Lake, Big Grassy, Big Island, Big Trout Lake, Cat Lake, Couchiching, Fort Hope, Fort William, Garden River, Ginoogaming, Grassy Narrows, Gull Bay, Kasabonika, Lac La Croix, Lac Seul, Landsdowne House Settlement, Long Lake, Manitou Rapids, Naicatchewenin, Northwest Angle, Osnaburgh, Pic Heron, Pic Mobert, Pikangikum, Rankin, Rat Portage, Sabaskong, Sachigo Lake, Sandy Lake, Seine River, Shoal Lake, Spanish River, Weagamow Lake, Webequie, West Bay, White Dog (Islington), Whitefish Bay, Whitefish River, Wikwemikong and Wunnumin Lake.

APPENDIX D

SERVICES NOT PROVIDED BY THE FORENSIC LABORATORY

1. Alcoholic Beverage Analysis

Contact:
Laboratory of the Liquor Control Board
55 Lakeshore Blvd. East
Toronto, Ontario
M5E 1A4
(416) 864-6725

2. Animal Examinations:

a) Blood Grouping

Contact:
Agriculture Canada
Animal Disease Research Institute
Blood Grouping Lab
3851 Fallow Field Road
P.O. Box 11300, Station "H"
Nepean, Ontario
K2H 8P9
(613) 998-9320

The Animal Disease Research Institute can group animal blood in the liquid form only.

b) Poisoning of Animals

Contact:
Animal Health Lab
University of Guelph
Bld. 49, P.O. Box 3612
Guelph, Ontario
N1G 2W1
(519) 824-4120 Ext. 4502

c) Age of Meat (cold storage time)

Contact:
Ontario Veterinary College
Dept. of Veterinary Microbiology & Immunology
University of Guelph
Guelph, Ontario
N1G 2W1
(519) 824-4120 Ext. 4999

3. Climatology (Forensic)
Contact: Environment Canada
Ontario Climatology Centre
25 St. Clair Avenue East
8th Floor, Room 831
Toronto, Ontario
(416) 739-4507

4. Clinical Diagnostic Tests
Contact: Local Hospital(s)

5. Counterfeit Bank Notes
Contact: R.C.M. Police
Central Bureau for Counterfeit
1200 Vanier Parkway
Ottawa, Ontario K1A 0R2
(613) 993-0664

6. Diving Equipment Checks - Contact: Private Sector
Suggested Contacts:
Integrity of gases

Novamann (Ontario) Inc.
5540 McAdam Road
Mississauga, Ontario
L4Z 1P1
(905) 890-2555

7. Drug related material involved in charges under the Narcotic Control Act and/or the Food and Drug Act only.

Contact: Laboratories of the Health Protection Branch
Health and Welfare Canada in
Ottawa, Toronto and Winnipeg.

Ottawa: Banting Research Centre
Tunney's Pasture
Ottawa, Ontario
K1A 0L2
(613) 957-1059

Toronto: 2301 Midland Avenue
Scarborough, Ontario
M1P 4R7
(416) 973-1600

Winnipeg: 510 Lagimodière Boulevard
Winnipeg, Manitoba
R2J 3Y1
(204) 983-5490

8. Fingerprinting

Contact: Appropriate police identification unit or:

Ontario Provincial Police
Forensic Identification Services
777 Memorial Avenue
Orillia Ontario
L3V 7V3
(705) 329-6352

9. Flammability Testing of Textile Material

Contact: Dept. of Textiles, Clothing & Footwear
Fire & Flammability Centre
ORTECH
Sheridan Park
2395 Speakman Drive
Mississauga, Ontario
L5K 1B3
(905) 822-4111
Ext. 493 (Textiles, Clothing and Footwear)
Ext. 434 (Fire and Flammability Centre)

10. Food Poisoning (spoiled food)
When the examination of food or body tissue is associated with suspected food poisoning,
Contact: Laboratory Services Branch
Ontario Ministry of Health
81 Resources Road
Etobicoke, Ontario
M9P 3T1
(416) 235-5716

11. Fraudulent Cheque File Services
Contact: Fraudulent Cheque File
Crime Index Section
R.C.M. Police
1200 Vanier Parkway
Ottawa, Ontario
K1A 0R2
(613) 998-6354

12. Mechanical Examinations (Motor Vehicle)
Contact: A licensed mechanic and then, if fault is suspected, the Centre of Forensic Sciences should be consulted.

13. Polygraph Testing
Contact: Ontario Provincial Police
Polygraph Services
777 Memorial Avenue
4th Floor
Orillia, Ontario
L3V 7V3
(705) 329-6530

14. Paternity Testing
Contact: Private Sector

15. Pathology Services (Forensic)
    Contact: Forensic Pathology
    26 Grenville Street
    Toronto, Ontario
    M7A 1Y6
    (416) 314-4040
16. Roadside Screening Devices Training
    Contact: Local Police Departments

17. Stab Wounds in tissue of deceased
    Relating a particular weapon or type of weapon to stab wound(s).
    Contact: Pathologist performing the autopsy.

18. Tachometer (Automotive) Testing
    Contact: Private Sector

19. Time of Death estimation relative to degree of digestion of stomach content.
    Contact: Pathologist performing the autopsy.

20. Venereal Disease Testing
    Contact: Local hospital laboratory
    and/or

    Laboratory Services Branch
    Ontario Ministry of Health
    81 Resources Road
    Etobicoke, Ontario
    M9P 3T1
    (416) 235-5952

NB: In situations where an acceptable alternate source of service cannot be located in the private sector or when in doubt relative to a particular analysis, contact the Centre Receiving Office, (416) 314-3216.

INDEX

Accelerants, see Fire accelerants
Adhesives, 78
Adhesive tape comparison, 116
Alcohol, in blood, 124, 126, 128, 129, 139, 140, 143, 144
    in liquor, 153
    in urine, 125, 128, 129, 144
    in vitreous humor, 128
    container kits, approved, 18, 144
Ammunition, 106, 107
Animal, hair, 24, 57, 58
    age of meat, 153
    blood grouping, 153
    poisoning, 153
Arson, 139 see also Flammable liquids
Automobile, see Vehicle
Automotive pedals, 120, 139
Autopsy samples, 134
Bags for packaging, 12, 13, 26, 27, 66, 68, 133
Bags (plastic) for comparison, 118
Bank notes, 101
Basic Procedures, 12, see also Part II
    marking items for identification, 12
    packaging and labelling, 12
    documentation, 13
    continuity of items, 17
Biology service, 23
Blood fluid, 40, 55
    for alcohol, 126, 128, 129, 143, 144
    for carbon monoxide,126, 140
    collection at autopsy, 44, 126, 134
    for drugs/poisons, 126, 128, 129, 144
    for DNA profiling, 40, 44
    tubes, 19, 40, 126
Blood stain, 28
    collection and packaging,28
    DNA profiling, 40
    identification of, 55
    pattern interpretation, 35, 55
Body tissues, for DNA, 44
    for Toxicology, 128
    for identification, 47, 133
Bombs, 70, 139
Bones, 44
Botanical materials, 35, 46, 51, 59
Break, enter and theft, 138
Breakage, of glass, 64
    of metals, 82, 83
Breath testing, 130
    training, 130
    roadside screening devices, 131
Buccal swabs, 41
Bullets, 106
    from body, 106
    suspected bullet holes, 75
Buttons, 52
Cables, 81
Car, see Vehicle
Carbon monoxide, 129, 140
Cartridges, see Ammunition
Case Submission Form, 13, 18
Casts, 80, 111
Charred Documents, 102
Chemistry service, 61
Cheque protectors, 97
Cheques, comparison writing, 94
    counterfeit, 101
    fraudulent, 103
Cigarette butts, 32, 41, 57

Climatology, forensic, 154
Clinical diagnostic tests, 125, 154
Clothing, 27, 74, 108, 134
    and arson, 68, 141
    blood on, 26, 27
    firing distance determination, 108
    hit and run, 141
    packaging of, 12, 27, 134
Collected writing, 94
Comparison samples, see specific type of material for examination
Computer printers, 100
Concrete, 71
Continuity, 17
Copying machines, 98
Cosmetics, 76
Counterfeit bank notes, 101
Dictated writing, 95
Diving equipment examination, 154
Documents examination service, 93
Documents, altered, 102
    charred, 102
    copies of, 94
    damaged, 94
    fingerprints on, 94
    fragile, 94
DNA Profiling, 40, 46, 47, 48, 50, 53
DNA Warrant Sample Collection Kits, 18
Drugs, analysis of, 123-130, 139, 140, 143
    in blood, 126, 129, 143
    in body tissue, 128
    in urine, 126, 129, 144
    under Narcotic Control Act, 125, 155
Drying of clothing, 27
Electrical/Electronic devices, 90
Electrocutions, 90
Epithelial cells, 47
Erasures, on paper, 102
    of serial number, 85, 111
Evidence, return of, 18
    submission of, 13-17
Explosions, 70, 139
Explosives, 70, 139
Fabric, flammability of, 155
    impressions, 25, 51
Faeces, 50
Fatal motor vehicle collisions, 124, 139
Fax machines, 98
Fetal tissue, 48
Fibres, 25, 26, 32, 45, 51, 58, 133, 138, 141, 142, 146
Films, from bank hold-ups, 121
Fingernail scrapings, 46
Fingerprinting, 155
Fingerprints, on blood stained items, 28
    on documents, 94
    on firearms, 107
Fire accelerants, 66, 139
Fire deaths, 140
Firearms and Toolmarks examination service, 105
Firearms discharge residues, 73
    on body tissue, 109, 111, 142
    on clothing, 74, 108
    on hands, 73
Fire debris, 66, 139
Fires and Explosions, 139
Fireworks, see Explosives
Firing distance determination, 108
Flammable liquids, 66, 139
Food, bacterial poisoning, 125, 156
    chemicals added, 125
    in stomach contents, 49
Footwear impressions, 119
Forged documents, 93
Forms, Case Submission, 13, 18
    gunshot residue from hands, 149
Fraudulent file, 103
Fur, see Hair

Gaming Machines, 91
Gases, 69
Gasoline, see Flammable liquids
General Information, 9
    role of forensic science, 10
    basic procedures, 12
    materials supplied by the Centre, 18
Glass, 64, 138, 141
Grease, 78, 141
Guns, see Firearms and Toolmarks examination service
Gunshot residues, on hands, 73
    on clothing, 74
see also Firearms discharge residues
Hair, animal, 24, 57, 58
Hair, human, 57, 58, 138, 141, 144
    for comparison, 26, 32, 44, 57
    for DNA profiling, 41, 58
Handprinting, 94
Handwriting, 94
Hit and run, 141
Homicide and obscure deaths, 142
Identifying items, 11, 12
Impaired driving, 143
Indentations and offsets, 102
Ink, 103
Knives, packaging, 27-28, 112
    penetration in clothing, tissue, 28
Labels on items submitted, 12
Ligature marks, 135
Lights, 84, 139
Liquor, alcohol analysis of, 153
Liver, 128
Lubricants, 78
Lungs, 68, 128, 140
Maggots, 50, 136
Magnetic recordings, 89
Matches, paper for comparison, 118
Materials supplied by the Centre, 18
Mechanical failures, 83, 139
Metallurgical testing, 83
Metals, 82
Mortar, 71
Narcotics, see Drugs
Nitroglycerine neutralizer, 19
Noxious substances, 77, 123
Oil, see Grease
On-call service, 10
Oral Swabs, 41, 134, 146
Organs, body, 128-129
Packaging, 12 — see also specific material
Paint, 62, on clothing, 62
    on tools, 62
    on vehicles, 62-63, 139, 141
Paper, 93
Paternity testing, 156
Pathology services, 133
PCR analysis, 54
Pedals, automotive, 120, 139
Pellets, see Ammunition
Pens, pencils, 103
Photocopiers, 98
Photographs, for examination, 121
Photoanalysis service, 115
Physical comparison, 116, 119
Pills, see Drugs
Pistol, see Firearms and Toolmarks examination service
Plant material, 35, 46, 51, 59
Plaster, 71
Plastic bags for comparison, 118
Plastics, 72
Poisons, in animals, 153
    in deceased persons, 126-128
    in living persons, 129
Polygraph testing, 156
Post Blast analysis, 70

Powder patterns, 108-109, 142
Preservative for blood and urine in
    alcohol and drug analysis, 126
Printed documents, 93
Rape, see Sexual Assaults
Recordings, 87-89
Regions of Ontario served by NRFL, 151
Report, laboratory, 10
Resins, 72
Revolver, see Firearms and Toolmarks
    examination service
RFLP analysis, 54
Rifle, see Firearms and Toolmarks
    examination service
Roadside screening devices, 131
Role of Forensic Science,10
Rope, 52
Rubber stamps, 101
Safe insulation, 71
Saliva, 31-32, 41, 56-57
Sand, see Soil
Scene, attendance at, 10
Seals, use of, 12-13
Semen, stains, 30, 56
    in vaginal samples, 56
Serial number restoration,
    on firearms, 111
    on metal surfaces, 85
    kits, 19
Services not provided by the
    Laboratory, 153
Sexual assaults, 144
    evidence kits, 19, 30, 144
    samples required, 30, 144
Shells, see Ammunition
Shoes for comparison, 120, 139
Shot patterns, see Firearms
    discharge residues
Signatures, 94
Skid marks, 86-87, 139
Skin, see Tissue
Soil, 78-81, on clothing, 79
    in clumps, 79
    on other surfaces, 79, 80
Sound recordings, 87-89
Speed, estimation of, 86, 139
Spermatozoa, motility of, 31, 56
    in vasectomies, 56
Stains, see specific material
Stomach contents for drugs/poisons, 128
    identification of, 49, 133
String, 52
Submission of evidence, 13-17
    form, 13, 18
Supplies, 18
Swabs, 27, 29-31, 134
    for DNA profiling, 41
    vaginal, 30, 31, 134, 144
Tape, for collection of evidence, 33
    comparison of, 116
Tape recordings, 87-89
Taping for fibres, 33
Tear gas, 77
Tears, in clothing, 27
Tires, in collisions, 85
    in slashings, 113
Tissue for DNA profiling, 44
    for drugs, 128
    with gunshot wound, 109, 111, 142
    for identification, 48, 133
    with stab wound, 27-28
Toolmarks, 111-112
Tools, 111-112
Toxicology service, 123
Typewriters, typewriting, 96
Urine, for alcohol, 128, 129, 143
    for drugs, 128, 129, 143
    for identification, 48
Vaginal samples, 30, 31, 47, 56, 144

Vegetation, 35, 46, 51, 59
Vehicle, hit and run, 141
    lights, 84, 139
    speed, 86, 139
    structural failure, 83, 139
    submission of, 17
Venereal disease, testing, 157
Video tapes, for enhancement, 121
Vitreous humor, for alcohol, 128
Voice identification, 87
Vomitus, 49
Wadding, see Ammunition
Weapons, see Firearms and Toolmarks
    Examination Service
Wires, 81
Wood, 35, 46, 59
Wounds, gunshot, 109, 136
    stab, 27-28
Writing, 94